OCTOBER Reg. U.S. Pat. Off. 25 CENTS

Popular Science

Founded MON

Perpetual Motion?
See page 26

The New Inventions and Discoveries—with 300 Pictures

With acknowledgments to K. C. B.

Every man in the class knew the answer

PROFESSOR HASKINS,
WAS A kindly soul.
BRIGHT ON some subjects.
BUT SO absent-minded.
THAT ONE day at the barber's.
HE TOOK off his collar.
TO GET shaved.
AND FORGOT where he was.
AND KEPT right on.
TILL THE cash-girl screamed.
AND A barber stopped him.
HE WAS a great smoker.
BUT HE'D often put.
THE BURNT match in his mouth.
AND THROW away.
THE CIGARETTE.
HIS STUDENTS loved him.
HE WAS so full.
OF FUNNY surprises.
ONE DAY he had a tube.
OF RADIUM and he told.
THE STUDENTS all about it.
AND FINALLY, by mistake.
INSTEAD OF the tube.
HE PULLED out one.
OF HIS cigarettes.
AND ASKED the class.
"WHAT IS the one thing.
WHICH DISTINGUISHES.
THIS MARVELOUS substance.
FROM ALL others on earth?"
AND THE class roared.
"THEY SATISFY."

WHAT is it you've always wanted a cigarette to do? You know the answer. Chesterfields do it—they not only please your taste, they *satisfy!* It's all in the blend—a *secret* blend of fine Turkish and Domestic tobaccos. It puts Chesterfields where no other cigarette can touch them for quality and value.

They Satisfy **Chesterfield**
CIGARETTES

Liggett & Myers Tobacco Co.

Watch the next truck you see pounding along on solid tires—listen to it jarring from bump to bump in the roadbed. Is it any wonder the average truck engine needs frequent repairs and adjustments?

Watch a solid-tired truck trying to pull a load in soft mud or on a wet, slippery road. Lack of traction wastes half the engine's power.

The old type solid tire is fast becoming obsolete. It does not protect the truck; it does not give traction.

What is to take its place? Owners of many of the largest truck fleets in America have found the answer in Kelly Caterpillars, the first cushion type tires to be successfully used on trucks of all weights and sizes.

The Caterpillar is resilient. It gives amazing traction. It gives phenomenal mileage. It has every advantage of the big pneumatic with none of the pneumatic's disadvantages. It costs less than the big pneumatic and gives double the mileage.

And it is *dependable*.

Kelly-Springfield Tire Co.

GENERAL SALES DEPARTMENT

1710 Broadway **New York, N. Y.**

Popular Science Monthly

OCT., 1920

Volume 97-No. 4

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(Continued on page 4)

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States, $3.00, Canada, $3.50, Foreign, $4.00. Single copy, 25 cents.

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H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

Modern Publishing Company
225 West Thirty-sixth St. New York City

How I Improved My Memory In One Evening

The Amazing Experience of Victor Jones

"OF *course* I place you! Mr. Addison Sims of Seattle.

"If I remember correctly—and I *do* remember correctly—Mr. Burroughs, the lumberman, introduced me to you at the luncheon of the Seattle Rotary Club three years ago in May. This is a pleasure indeed. I haven't laid eyes on you since that day. How is the grain business? And how did that amalgamation work out?"

The assurance of this speaker—in the crowded corridor of the Hotel McAlpin—compelled me to turn and look at him, though I must say it is not my usual habit to "listen in" even in a hotel lobby.

"He is David M. Roth, the most famous memory expert in the United States," said my friend Kennedy, answering my question before I could get it out. "He will show you a lot more wonderful things than that, before the evening is over."

And he did.

As we went into the banquet room the toastmaster was introducing a long line of the guests to Mr. Roth. I got in line and when it came my turn Mr. Roth asked, "What are your initials, Mr. Jones, and your business connection and telephone number?" Why he asked this I learned later, when he picked out from the crowd the 60 men he had met two hours before and called each by name without a mistake. What is more, he named each man's business and telephone number, for good measure.

I won't tell you all the other amazing things this man did except to tell how he called back, without a minute's hesitation, long lists of numbers, bank clearings, prices, lot numbers, parcel post rates and anything else the guests gave him in rapid order.

"Of Course I Place You! Mr. Addison Sims of Seattle."

When I met Mr. Roth—which you may be sure I did the first chance I got—he rather bowled me over by saying, in his quiet, modest way:

"There is nothing miraculous about my remembering anything I want to remember, whether it be names, faces, figures, facts or something I have read in a magazine.

"*You can do this just as easy as I do.* Any one with an average mind can learn quickly to do exactly the same things which seem so miraculous when I do them.

"My own memory," continued Mr. Roth, "was originally very faulty. Yes, it was—a really *poor* memory. On meeting a man I would lose his name in thirty seconds, while now there are probably 10,000 men and women in the United States, many of whom I have met but once, whose names I can call instantly on meeting them."

"That is all right for you, Mr. Roth," I interrupted, "you have given years to it. But how about me?"

"Mr. Jones," he replied, "I can teach you the secret of a good memory in one evening. This is not a guess, because I have done it with thousands of pupils. In the first of seven simple lessons which I have prepared for home study, I show you the basic principle of my whole system and you will find it—not hard work as you might fear—but just like playing a fascinating game. I will prove it to you."

He didn't have to prove it. His course did; I got it the very next day from his publishers, the Independent Corporation.

When I tackled the first lesson, I suppose I was the most surprised man in forty-eight states to find that I had learned in about one hour, how to remember a list of one hundred words so that I could call them off forward and back without a single mistake.

That first lesson *stuck*. And so did the other six.

Read this letter from Terence J. McManus, of the firm of Olcott, Bonynge, McManus & Ernst, Attorneys and Counsellors at Law, 170 Broadway, and one of the most famous trial lawyers in New York:

> "May I take occasion to state that I regard your service in giving this system to the world as a public benefaction? The wonderful simplicity of the method, and the ease with which its principles may be mastered, especially appeal to me. I may add that I already had occasion to test the effectiveness of the first two lessons in the preparation for trial of an important action in which I am about to engage."

Mr. McManus didn't put it a bit too strong. The Roth course is priceless. I can absolutely count on my memory now. I can call the name of most any man I have met before—and I am getting better all the time. I can remember any figures I wish to remember. Telephone numbers come to mind instantly, once I have filed them by Mr. Roth's easy method. Street addresses are just as easy.

The old fear of forgetting (you know what that is) has vanished. I used to be "scared stiff" on my feet—because I wasn't *sure*. I couldn't remember what I wanted to say.

Now I am sure of myself, and confident, and "easy as an old shoe" when I get on my feet at the club, or at a banquet, or in a business meeting, or in any social gathering.

Perhaps the most enjoyable part of it all is that I have become a good conversationalist—and I used to be as silent as a sphinx when I got into a crowd of people who knew things.

Now I can call up like a dash of lightning most any fact I want right at the instant I need it most. I used to think a "hair trigger" memory belonged only to the prodigy and genius. Now I see that every man of us has that kind of a memory if he only knows how to make it work right.

I tell you it is a wonderful thing, after groping around in the dark for so many years to be able to switch the big searchlight on your mind and see instantly everything you want to remember.

This Roth course will do wonders in your office.

Since we took it up you never hear anyone in our office say "I guess" or "I think it was about so much" or "I forgot that right now" or "I forget that right now" or "I can't remember," or "I must look up his name." Now they are right there with the answer—like a shot.

Have you ever heard of "Multigraph Smith?" Real name H. O. Smith, Division Manager of the Multigraph Sales Company, Ltd., in Montreal. Here is just a bit from a letter of his that I saw last week:

> "Here is the whole thing in a nutshell: Mr. Roth has a most remarkable Memory Course. It is simple, and easy as falling off a log. Yet with one hour a day of practice, anyone—I don't care who he is—can improve his memory 100% in a week and 1000% in 6 months."

My advice to you is don't wait another minute. Send to Independent Corporation for Mr. Roth's amazing course and see what a wonderful memory you have got. Your dividends in *increased power* will be enormous.

VICTOR JONES.

While Mr. Jones has chosen the story form for this account of his experience and that of others with the Roth Memory Course, he has used only facts that are known personally to the President of the Independent Corporation, who hereby verifies the accuracy of Mr. Jones' story in all its particulars.

Send No Money

So confident is the Independent Corporation, the publishers of the Roth Memory Course that once you have an opportunity to see in your own home how easy it is to double, yes, triple your memory power in a few short hours, that they are willing to send the course on free examination.

Don't send any money. Merely mail the coupon or write a letter, and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied, send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

Independent Corporation

Dept. R-7710 319 Sixth Ave. New York

FREE EXAMINATION COUPON

Independent Corporation

Publishers of The Independent Weekly

Dept. R-7710 319 Sixth Ave. New York

You may send me the Course or Courses checked below. Within five days after receipt I will either remail them or send you $5 for each in full payment except as noted.

- ☐ Roth Memory Course ($5) By David M. Roth
- ☐ Drawing, Art, Cartooning Course ($5) By Charles Ledyer
- ☐ How to Read Character at Sight ($5) By Dr. L. M. H. Blackford
- ☐ Sales-Salesmanship ($5) By Arthur Newcomb
- ☐ Practical Course in Personal Efficiency ($5) By Edward E. Purinton
- ☐ Money-Making Account System ($5.50) By Wesley W. Parrin
- ☐ Mastery of Speech ($5) By Frederick Hook Law

Name .....

Address .....

..... Pop Sc Mthly 10-20

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MEDICINE AND SURGERY

MISCELLANY

MOTOR VEHICLES AND ACCESSORIES

(*Continued on page 8*)

SAVE $36

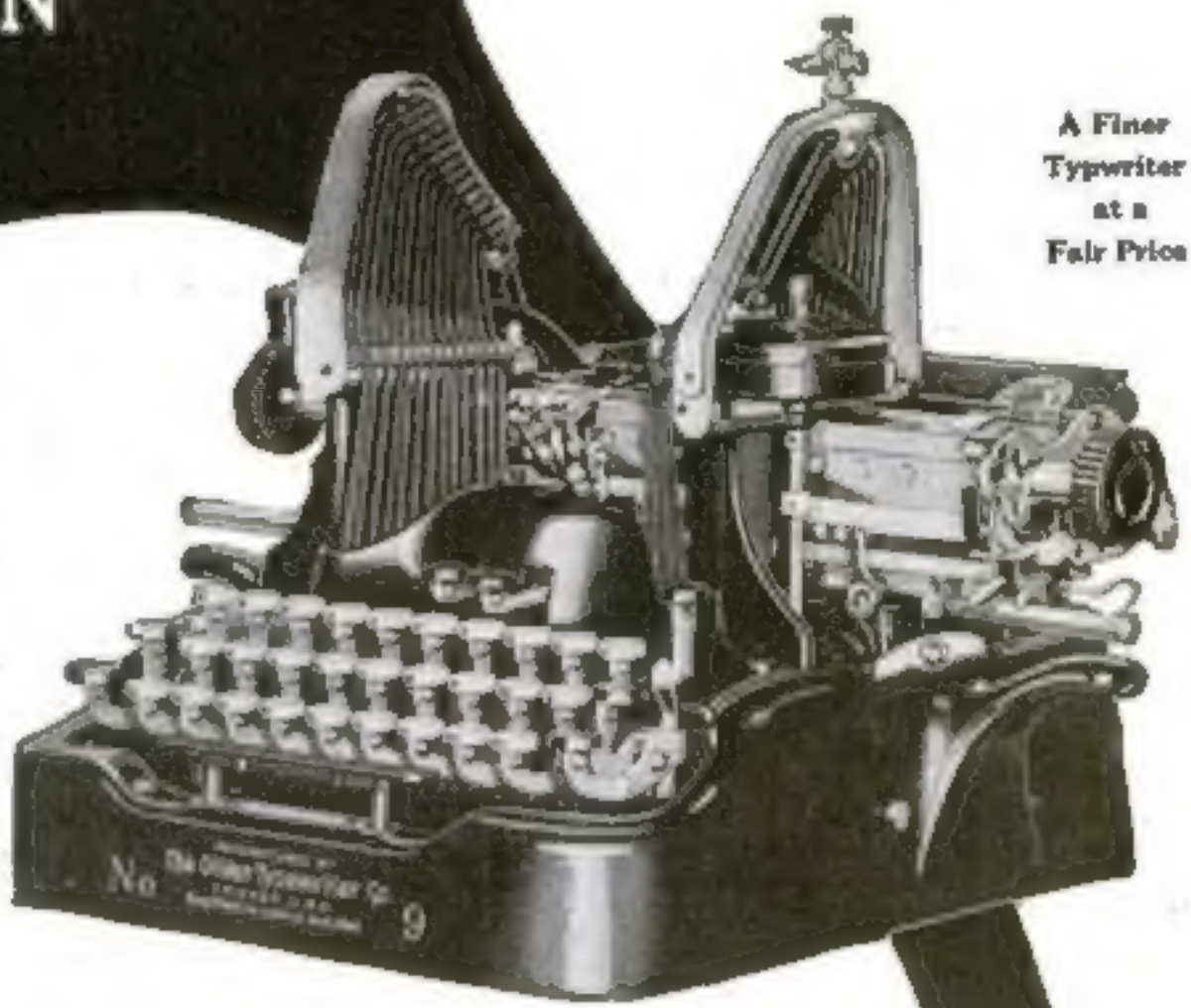
New $100 Oliver only $64

SEND NO MONEY

ONLY THE COUPON

Pre-War Price $100
Now $36 Less

In these days when the cost of many things is higher than before the war, it is a distinct contribution to business economy to offer through more direct selling methods such a great and decided saving on so popular a typewriter as the Oliver.



A Finer Typewriter at a Fair Price

YES, we will ship you a new Oliver for five days' free trial in your home or office without a cent in advance from you. Mail only the coupon—no money. Use the Oliver all you wish for five days. Choose for yourself whether you want to keep it or not. If you decide to buy, pay only $4 a month. If you don't want to keep the Oliver, send it back at our expense. We even refund outgoing charges; so you can't lose a penny on this offer.

Our new plan

Our new plan saves you $36. It gives you a new $100 Oliver for only $64. If we were selling the old way we would still have to charge $100 for the Oliver. But during the war we learned many economies. We found that it was unnecessary to have such a vast number of traveling salesmen and so many expensive branch houses. We were able to discontinue many other superfluous sales methods. As a result, $64 now buys the identical Oliver formerly priced at $100.

Famous Oliver users

U. S. Steel Corporation
Boston Woven Hose & Rubber Co.
National City Bank of N. Y.
Morris & Company
Encyclopedia Britannica
Boston Elevated Railway
Otis Elevator Co.
Corn Products Refining Co.
N. Y. Edison Co.
Columbia Graphophone Co.
Hart, Schaffner & Marx
Holeproof Hosiery Co.

Pay only $4 a month

Take over a year to pay for your Oliver and have the use of the machine all the time. Only $4 a month is all you need remit. Think of getting a brand new Oliver No. 9 on terms so easy as to average only about 13 cents a day. No longer is it necessary for anyone to think of putting good money into a second-hand or rebuilt machine.

Mail the coupon

Send no money on this offer. The coupon brings the Oliver for free trial. Fill it out now and mail at once. Don't hesitate, for you risk nothing. If, however, you should wish our catalog before ordering, simply mark the coupon accordingly. But the better way is to get the Oliver for free trial and judge it by actual use!

Canadian Price, $82

The OLIVER Typewriter Company
1107 Oliver Typewriter Building, Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY,
1107 Oliver Typewriter Building, Chicago, Illinois

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for.

My shipping point is.....
This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....
Street Address.....
City..... State.....
Occupation or Business.....

CONTENTS—*Continued*

NATURAL SCIENCE

PICTORIAL PAGES

SPORTS AND PASTIMES

PRACTICAL WORKERS

QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 30 Cents a Word. Advertisements intended for the December issue should be received by October 1st.

AUTOMOBILES AND ACCESSORIES

AUTO MOTOR SUPPLIES—Buick, Michigan, Stoddard Dayton, Cadillac, Overland, E. M. F., Continental and Delco Motors all types $10 each and up. Special high tension 3 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (14) West End, Pittsburgh, Pennsylvania.

SALESMEN—Agents—Everywhere: Sell "Tankli" Motors auto-fuel. Guaranteed; 100 to 200% profit. Every prospect interested. Exclusive territory. Tankli, Cleveland, Ohio.

AUTOMOBILE Parts for all cars—10% off manufacturers' list price. Pistons, connecting rods, cam shafts, crank shafts, cylinders, axles and gears. Our new catalogue and Used Parts Bulletin now ready. Write for it to-day. Service and satisfaction guaranteed. Auto Parts Company, 4108 Olive Street, St. Louis, Missouri.

TIRES, Factory-to-You Prices. Exclusive representative wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Equal 6000 Miles. Sample sections furnished. Mellinger Tire Company, 937 Oak Street, Kansas City, Missouri.

Vulcanizing auto tires is a growing and profitable business. Easy to learn. Instruction book, $1. Plants $50 to $300. Details free. Equipment Co., 17 Canal, Cincinnati, Ohio.

PATENTS—Write for Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest references. Reasonable terms. Victor J. Evans & Company, 180 Ninth, Washington, D. C.

BIG profits to agents selling Insure Tires. Double mileage. Prevent blowouts and punctures. Fully guaranteed. Fast seller. Liberal profits to agents. Auto-accessory Sales Co., Q 642 W. Jackson Blvd., Chicago, Illinois.

BULL dog inner tires molded to fit your casings. Practically eliminates blow-outs and punctures. Doubles the life of your tires. Wonderful seller and repeat order getter. Write for particulars to-day. Agents making $5,000 to $10,000 a year. Eastern Auto Specialty Co., Dept. B, Utica, New York.

"PROTEXUN" fits your regular plug. Stops porcelain breakage. Keeps out rain. Prevents fires. Very interesting. Write for details. Ira Hicks, Centralia, Missouri.

AUTO-TOP and seat covers, $7 up, parcel post, prepaid. Easy to apply. Catalogue and samples free. Auto Equipment Company, 20 Canal, Cincinnati, Ohio.

BLUEPRINTS—Automobile generator armatures, see ad under "Electrical." Charles Chittenden.

WATER stills—heavy copper, one and three gallon sizes; $25.00 and $40.00. Most practical on market for distilling water for batteries, drinking and commercial use. Shipped prepaid on receipt of order. Mid-West Specialty Co., 5330 Monroe Street, Dept. 8, Chicago.

YOU can buy your favorite tires direct by mail at wholesale price and eliminate the dealer's profit. Don't purchase another tire until you receive our free wholesale price list on new standard tires. Write immediately. Akron Tire Sales Co. (Dept. F), Davenport, Iowa.

SPEEDSTER and Racing bodies. Build your own—save over half. Florida system of Auto-Body Building. Dept. D., North Chicago, Illinois.

INSYDE Tires, inner armor for automobile tires. Prevents punctures and blowouts. Doubles mileage of our tires. Liberal profits. Details free. American Accessories Co., Dept. 97A, Cincinnati, Ohio.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

FORD ACCESSORIES

FORDS run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Robs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days trial. Air-Friction Carburetor Company, 500 Madison Avenue, Dayton, Ohio.

TIMER Brush. New wiping contact; quick starting; easiest running. Only 34 cents, prepaid. R. Bp. Works, Box 547, Riverside, California.

FORD spark plug cores, complete, 17c; four, 56c. Specialty catalog with order. Mitrea Co., 242 East 125th Street, New York City.

FOR SALE

200 complete sets of mechanical drawing instruments must be sacrificed regardless of the cost. These mechanical drawing sets must be sold within 30 days—at less than wholesale prices. You will save the wholesaler's profit and the retailer's profit, by taking this wonderful opportunity now. If you buy now you will get the biggest bargain ever offered in mechanical drawing instruments. Send for our illustrated particulars free. National Instrument Company, 4517 North Lawndale Avenue, Chicago, Illinois.

EMPIRE candy floss machine. Electric or hand power, good as new. First $75 gets it. Baumgardt, 418 Boston Block, Minneapolis.

13 MICROSCOPES (B. & L.) All model with eyepiece and two objectives, circular double nosepiece. Price reasonable. H. E. Vick, Liberty, Missouri.

ELECTRICAL

BLUEPRINTS: 104 induction motor diagrams. Poles to 12. Single, Two and Three phase. Price $5.00. International Blueprint Company, Station "B," Kansas City, Missouri.

ELECTRICIANS, Wiremen, Linemen, send your name and address for descriptive literature of our Modern Blue Print Chart Method of Electrical Wiring. Over 350 practical diagrams. Electrical Wiring Diagram Company, Box 1175, Altoona, Pennsylvania.

MAKE Dry Batteries. Simple, practical instructions, with blue print, 25 cents. Dirigo Sales Company, Dept. Maine.

BLUEPRINTS—Electrical connections. Alternating and direct current motors, transformers, rheostats, controllers, compensators, automobile generator armatures. 10 samples 4. C. 25c. Catalog free. Charles Chittenden, 5302A Matthews Avenue, Kansas City, Missouri.

WELDING AND SOLDERING

WELDING apparatus for all purposes. Small payment, balance five to ten months. Every mechanic needs one. Our plan is interesting. Write to-day. Swing Welding Co., Cedar Rapids, Iowa, U. S. A.

MOTORS, ENGINES, MACHINERY

SMALL Motors and Generators. ¼ h. p. a. c. $24.50, ½ h. p. $38.50, ¾ h. p. a. c. $67.50. Battery charging sets. Charging lighting and moving picture are generators. Motors for all phases of current. Prompt delivery. Wholesale prices. Write for late catalog. Address Motor Sales Dept. (14), West End, Pittsburgh, Pennsylvania.

EXCHANGE

SWAP Bulletin. Three months, dime. Circulates every state. Circulars mailed. Advertisements, cent word. Detroit.

AVIATION

THE American School of Aviation announces a new correspondence course in Mechanics of Aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 1697, 431 South Dearborn Street, Chicago.

HEATH Airplane Co.'s Catalog "N" is the most complete booklet ever published on aeronautical goods. 12c in stamps. Get our pamphlet on Ford and Motorcycle engine-driven airplanes, 4c; also glider circular, 4c. We buy and sell all kinds of aeronautical motors. Heath Airplane Co., Chicago.

SPORT BIPLANE—Ford motored. Build or assemble your own at low cost. Parts for one wing, $25. Parts for body, $60. Etc. Engines, $200. Plans and very complete instructions for building, only $5. (You will learn a lot about aircraft mechanics.) Aviation Engineering Co., Lawrence, Kansas.

INVENTORS desiring information write for our Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

BUILD the Star Jr. Biplane. Send stamp for Circular "P." Chicago Aero Works, 52 River.

"MOTORCYCLE ENGINES" Monoplane. Very efficient for learning flying. Materials cost about $40. Plans and instructions for building and flying, $1. Aviation Directory, Lawrence, Kansas.

MOTORCYCLES, BICYCLES, SUPPLIES

MOTORCYCLES, $40.00 up. Side Cars, Evans Powercycles, Johnson Motor Wheels, and other rigid motor attachments. Send for our Big Bargain Bulletin and our "Money Saving Message to the Motorcyclist" (illustrated). It will save you money on motorcycles, side cars, bicycles, repair parts, tires and supplies. Our Repair Department is at your service. American Motor Cycle Company, Dept. 8, Chicago.

$25.00 Up—Guaranteed rebuilt motorcycles—Henderson, Excelsior, Indian, Harley-Davidson. Bicycles, $5.00 up. Tires and accessories at wholesale. Illustrated bulletin "A" free. Ash Motor Corporation, 182 North Clinton Avenue, Rochester, New York.

USED Motorcycle Bargains: Indians, Excelsiors, Harleys. $40.00 up. Singles or twins. Overhauled, rebuilt and tested by experts. Shipped on approval and guaranteed. Send stamp for Big Free List. We furnish bank references. Floyd Clymer, Desk A, "Largest Motorcycle Dealer in Western America," Denver, Colorado.

MANUFACTURING

WE do Metal Stamping, Die and Model Work, Gold, Silver, Nickel, Copper and Brass Plating, also special finishes. We will manufacture your article either on straight line or contract basis. When our tool or model maker is on your job, you are welcome at his bench. Deming Manufacturing Company, 1775-1777 East 87th Street, Cleveland, Ohio.

TO Order: Any article in metal; model, tools, patterns, experimenting, manufacturing. Inventions developed. Cleveland Specialty and Manufacturing Company, Cleveland, Ohio.

CENTRAL Machine Works, St. Louis, Missouri. Special Machinery builders manufacturing to any quantities, dies, tools, battery moulds, stampings and parts.

WIRELESS

SIMPLE Wireless Telephones and How to Make Them. A good book for the advanced radio amateur on the principles, construction and use of the wireless telephone. Price 25 cents postpaid. Book Dept., Popular Science Monthly, 225 West 39th Street, New York.

WANTED

CASH! Paid! if you want all your goods are worth, mail us your discarded jewelry, gold crowns, bridges, watches, diamonds, silver, platinum, magnets and contact points. We pay $1.00 to $24.00 per set for false teeth (broken or not).—Money sent by return mail. Packages held 5 to 15 days and returned at our expense if our offer is not satisfactory. Send to the old Reliable United States Smelting Works, Dept. 91, Chicago, Illinois.

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

WANTED—Small gasoline and steam engines, electric drills, motors, etc. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pennsylvania.

WANTED a copy of "How to Make Things Electrical." If you have a copy of this book you will sell, write giving the date of copyright. Book Dept., Popular Science Monthly, 225 West 39th Street, New York.

IT'S Like Finding Money when you mail us false teeth (with or without gold fillings), old or broken jewelry, diamonds, watches, old gold, silver, platinum, magnetic points, gold or silver ores or nuggets—War Bonds and Stamps. Highest prices paid. Cash by return mail. Goods returned if you're not satisfied. The Ohio Smelting and Refining Company, 229 Lennox Building, Cleveland, Ohio.

FORMULAS

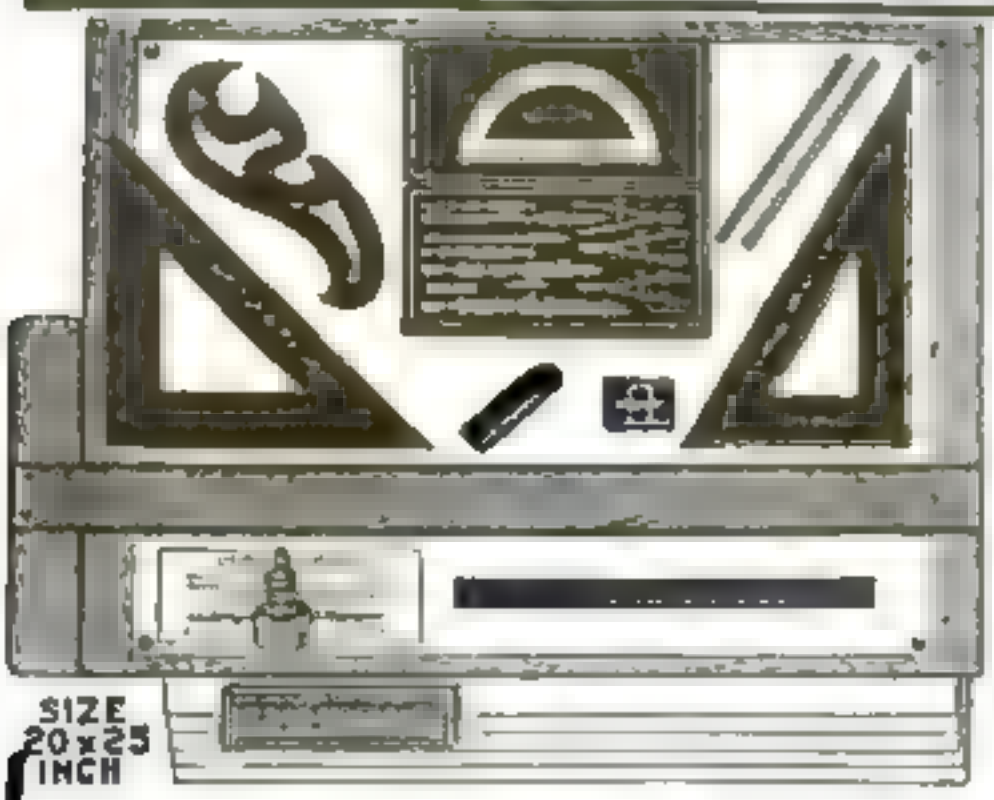
DEPENDABLE formulas for Automobile, Toilet and Food Specialties, including Industrial Processes. Lists 3c. Industrial Methods Bureau, 18 West 34th Street, New York City.

500 FORMULAS. Trade Wrinkles, Secrets, Discoveries. All easy, successful money-makers. Lists free. Every-thing 25c. Edgar James, 215 Douglass, Indianapolis, Indiana.

BEAUTIFYING cold cream. Money maker. Sell friends. Formula $1.00. Florence, 450 West 61 Place, Chicago, Illinois.

Quick-Action Advertisements continued on page 10

Drawing Outfit and Drawing Table FREE



Complete Set of Drawing Instruments and Drawing Table

Yes, I will give you this complete drawing outfit absolutely free. The instruments are in a handsome high class, plush lined folding case. They are regular draftsman's working instruments. Besides I will give you absolutely free, a 20 x 25 inch drawing board, a 24 inch T square, a 12 inch rule, a supply of drawing paper two triangles, a French curve, pencils, erasers, thumb tacks, etc.

Delivered at Once

The drawing table is the "Chief's Own" adjustable folding Drawing Table, same as used and needed by first class draftsmen. The complete outfit and table are delivered to you at once. You have them to work with from the very first day.

Be a Draftsman

Draw $250.00 to $300.00 Per Month

There is an urgent demand for skilled draftsmen. Companies are issuing calls every day for men to fill positions paying from $250.00 to $300.00 per month. Work is light, pleasant and profitable.

Chief Draftsman Will Instruct You Personally

I am Chief Draftsman of a large and well known firm. I have been doing the highest paying expert drafting work for a quarter of a century and I know just the kind of training that is demanded from men who get the big salaries. I train you by giving you actual, practical work, the kind that you must be able to do to hold permanent, big paying positions. I give you my individual instruction. If your work is right I will advance you rapidly. If it is wrong I will show you where and make you do it right, and do all I can to make you an expert draftsman and designer in a short time. *Write today without fail.*

Pay as You Wish

What I want is the *right kind* of men. Don't bother about expense. I will give you the working outfit free if you get in at once. I charge a very small fee for training you to be an experienced draftsman. You can pay the small cost as suits you best.

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Put your name and address on the coupon or a letter or a post card and send it to me today. I will send you, absolutely free and postpaid, my new book "Successful Draftsmanship," and the great special offer that I am now making so that you get the complete Draftsman's Working Outfit and Drawing Table absolutely free. You assume no obligation of any kind in sending in the coupon. Get on line for a big paying position. Getting the book and full particulars of the special offer is the first step. Don't delay—send the coupon today.

Chief Draftsman Dobe Dept. 1307 4001 Broadway, Chicago, Ill.

Chief Draftsman Dobe
Dept. 1307, 4001 Broadway, Chicago

Without any obligation on me whatsoever please mail your book, "Successful Draftsmanship," and full particulars of your liberal "Personal Instruction" offer to a few students. It is understood that I am obligated in no way whatever.

Name .....

Address .....

AMERICAN MADE TOYS

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MODELS AND MODEL SUPPLIES

INVENT. Be before selling your models or having machine work done call [illegible] Model and Machine Works [illegible] Avenue.

PATENTS— Book free. Send sketch for free opinion of patentable nature. Talbert & Talbert, 4616 Talbert Building, Washington, D. C.

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Why 60,000 Firms Force Me to Say This to You

An Important Message From the Vice-President of The American Commerce Association. He Tells Why the Needs of 60,000 Concerns Have Forced Him to Appeal for Men Willing to Become Traffic Managers at $3,000 to $5,000 and More a Year.

By E. J. MARTIN
Vice-President, The American Commerce Association

As a last resort, I am writing this message in a final effort to acquaint you with the splendid opportunities open in the traffic management and to tell you how, through a special Association organized for this purpose you can quickly obtain an excellent traffic position and a salary of from $3,000 to $5,000 or more a year.

The issuance of this message has practically been forced upon me by the tremendous needs of more than 60,000 firms requiring trained traffic men. Although there was a big need for traffic managers before and during the war, yet it is nothing compared to today's great need for trained traffic men as a result of the tremendous business expansion. In this message I want to tell you what a traffic manager is, why he is so vitally needed and how you can get your share of the splendid opportunities offered you by this high-paying profession.

Transportation, the Second Largest Business in America, Needs Your Services

[illegible]

Traffic Men Earn Big Money Because They Save Their Firms Big Money

[illegible]

New Way Puts You Quickly in Big Traffic Positions

[illegible]

Mail Coupon for Free Book Giving Full Information

[illegible]

AMERICAN COMMERCE ASSOCIATION
Dept. 6-K, 4043 Drexel Boulevard Chicago, Ill.

AMERICAN COMMERCE ASSOCIATION
Dept. 6-K, 4043 Drexel Boulevard, Chicago, Ill.

Please send me, without obligation on my part, your free book on Traffic Management. Also tell me how I can qualify for a big traffic job.

Name

Address

Age Occupation

[illegible] double its mileage. Prove for yourself [illegible]

[illegible] Tuscorora—They novel [illegible] and cigar stores, [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

DISTRICT Managers to sell three high class photographs direct to farmers and dealers. Guaranteed selling [illegible] I will finance you, furnish you samples, help you get your Ten Thousand Dollar year clean. Nat Kavin Great Eastern Manufacturers Company, 210 South Wabash Avenue [illegible]

WANTED 3 year round quick sales interest [illegible] Dept. 10, Martinek Co., 108 Lexington Avenue, New York.

[illegible]

HELP WANTED

[illegible]

BE a Movie Expert. $3-$10 a day spare time home [illegible]

[illegible]

BUSINESS OPPORTUNITIES

[illegible] Walter Sanford, Nashville, reports [illegible] gross earnings last year [illegible] March. O. H. Overholser [illegible] farm. Start now to spare time [illegible] Write today [illegible] Detroit, Michigan.

[illegible]

[illegible] Harvey Tarpy, Jeffersonville, Indiana.

ART leaded prized glass window work, beautiful effects [illegible] Illustrated particulars free. [illegible] Wheeler, 30 [illegible] New York.

$ MAKE $30 a week [illegible] Address, Lorenz, New York.

[illegible]

[illegible] specialty; openings [illegible] can attend to easily [illegible] to buy job hunting, soliciting or agency. Address Stephenson Laboratory, 15 Huck Bldg, Boston, Mass.

[illegible]

BUILD a genuine [illegible] and more snap bait. Fine profits [illegible] Fishers & Tackers, 1447 Tackers Building [illegible]

[illegible]

[illegible]

STAMPS AND COINS

[illegible]

[illegible] Approvals.

100 Genuine Foreign Stamps—Stolen War Issues, Tasmania, Salvador and India Service, Guatemala, China. [illegible]

STAMPS, 50 All Different, 3 cents. Stamps paper, Quaker Camp Co., Toledo, Ohio.

[illegible]

CALIFORNIA gold, quarter size and Columbia Nickel, 50c. Vida coin and catalog, 10c. Hunter Pelvitia, Utica [illegible]

[illegible]

"You've Gone Way Past Me, Jim!"

"Today good old Wright came to my office. All day the boys had been dropping in to congratulate me on my promotion. But with Wright it was different.

"When I had to give up school to go to work I came to the plant seeking any kind of job. I was just a young fellow without much thought about responsibility. They put me on the payroll and turned me over to Wright, an assistant foreman then as now. He took a kindly interest in me from the first. 'Do well the job that's given you, lad,' he said, 'and in time you'll win out.'

"Well, I did my best at my routine work but I soon realized that if ever I was going to get ahead I must not only do my work well but prepare for something better. So I wrote to Scranton and found I could get exactly the course I needed to learn our business. I took it up and began studying an hour or two each evening.

"Why, in just a little while my work took on a whole new meaning. Wright began giving me the most particular jobs—and asking my advice. And there came, also, an increase in pay. Next thing I knew I was made assistant foreman of a new department. I kept right on studying because I could see results and each day I was applying what I learned. Then there was a change and I was promoted to foreman—at good money, too.

"And now the first big goal is reached—I am superintendent with an income that means independence, comforts and enjoyments at home, all those things that make life worth living.

Wright is still at the same job—an example of the tragedy of lack of training. What a truth he spoke when he said today, 'You've gone way past me, Jim,—and you deserve to. Heads win every time.'"

Yes, it's simply a question of training. Your hands can't earn the money you need, but your head can if you'll give it a chance.

The International Correspondence Schools have helped more than two million men and women to win promotion, to earn more money, to know the joy of getting ahead in business and in life.

Isn't it about time to find out what they can do for you?

You, too, can have the position you want in the work of your choice, with an income that will make possible money in the bank, a home of your own, the comforts and luxuries you would like to provide your family. No matter what your age, your occupation, your education, or your means—you can do it!

All we ask is the chance to prove it—without obligation on your part or a penny of cost. That's fair, isn't it? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7694, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ELECTRICAL ENGINEER
- Electric Lighting and Railways
- Electric Wiring
- Telegraph Engineer
- Telephone Work
- MECHANICAL ENGINEER
- Mechanical Draftsman
- Machine Shop Practice
- Toolmaker
- Gas Engine Operating
- CIVIL ENGINEER
- Surveying and Mapping
- MINE FOREMAN OR ENGINEER
- STATIONARY ENGINEER
- Marine Engineer
- Ship Draftsman
- ARCHITECT
- Contractor and Builder
- Architectural Draftsman
- Concrete Builder
- Structural Engineer
- PLUMBING AND STEAM FITTING
- Sheet Metal Worker
- Textile Overseer or Supt.
- CHEMIST
- Mathematics
- SALESMANSHIP
- ADVERTISING
- Window Trimmer
- Show Card Writer
- Sign Painter
- Railroad Trainman
- ILLUSTRATING
- Cartooning
- BUSINESS MANAGEMENT
- Private Secretary
- BOOKKEEPER
- Stenographer and Typist
- Cert. Public Accountant
- TRAFFIC MANAGER
- Railway Accountant
- Commercial Law
- GOOD ENGLISH
- Teacher
- Common School Subjects
- CIVIL SERVICE
- Railway Mail Clerk
- AUTOMOBILE OPERATING
- Iron Worker
- Navigation
- AGRICULTURE
- Poultry Raising
- Spanish
- French
- Italian

Name _____
Present Occupation _____
Street and No. _____
City _____ State _____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

Secrets of Selling that Make These Men $10,000 a Year Star Salesmen

Some Amazing Stories of Quick Success

IT is hard to believe that a man who has been working for years in a routine job at a small pay could almost overnight step into the $10,000 a year class. Yet that is just what many men have done and are doing today. That such big success could come so quickly and so easily seems almost incredible. But I should tell you that one man who had been a fireman on a railroad stepped from his old job to one that paid him $1,500 a year, you would be right to doubt the truth of my statement.

But I can show you the man's own story. And that is only one instance. I can show you many more. And perhaps the most surprising part of it all is that these men were just average men. They came from all walks of life, from all fields of work. They had previously been clerks, bookkeepers, mechanics, farm hands! Some of them had never earned more than $60 a month—some of them had drudged for years at dull, uninteresting work without prospects of anything better in life. And then, in one quick jump, they found themselves earning more money than they had ever thought possible. Suddenly all their dreams of success, position and financial independence came true.

Send Me Your Name

I have shown hundreds of men how to step from small pay jobs into the big money class in our quick jump. $10,000 a year—yes, and more—has come to them as a result of training in me. Just let me send you the whole amazing proof quickly free of cost or obligation. J. E. Greenslade, President, N. S. T. A.

The Secret of Their Success

What was responsible for their remarkable rise to the ranks of the big money makers? What did they do to lift themselves out of the low pay rut and step to magnificent earnings?

The answer is very simple. These men decided to get into the great field of *Selling*—they learned about the wonderful opportunities in this fascinating profession—why salesmen are always in demand—why they receive so much more money than men in other fields of work. And they became Star Salesmen!

Probably if you had told any one of these men that it was possible for him to become a Star Salesman he would have laughed at the idea. If you had told him that it was not only possible, but that it could be done in his spare moments at home, without interfering with his work, he would have dismissed your statement as being too absurd to be even considered. For you must remember that most of those men have never had a day's experience in Selling—they had no special qualifications for Salesmanship—no thought of ever becoming Salesmen.

What Makes a $10,000 a Year Star Salesman?

As a matter of fact, these men who are today reaping such handsome rewards as Star Salesmen, would probably be working still as clerks, bookkeepers, mechanics, etc., if they had not learned about the National Salesmen's Training Association's system of Salesmanship Training and Free Employment Service. This is an organization of top-notch Salesmen and Sales Managers formed just for the purpose of showing men how to become Star Salesmen and fitting them into positions as City and Traveling Salesmen.

Through its help hundreds of men have been able to realize their dreams of big opportunity, success, wealth and independence. Men without previous experience or special qualifications have learned the secrets of selling that make Star Salesmen. For Salesmen are not "born" but made, and any man can easily master the principles of Salesmanship through the wonderful system of the National Salesmen's Training Association. Anyone who is inclined to doubt that this is so has only to read the stories of men who tell in their own words what the Association has done for them. Here are just a few examples.

J. P. Greenstreet of Dallas, Texas, who was formerly on the Capitol Police Force of Washington, D. C., states: "My earnings for March were over $1,000 and over $[illegible] for the last six weeks, while last week my earnings were $[illegible]. The N. S. T. A. dug me out of the rut we were in, was earning less than $1,000 a year and showed me how to make a success."

C. W. Campbell of Greensburg, Pa., writes: "My earnings for the past forty days are $1,[illegible], and I won 3rd Prize in March although I only worked two weeks during that month."

F. F. Hatenaugh of Pittsburgh, Pa., who was formerly a fireman on an Eastern railroad, states: "You have put me in the $10,000 a year class."

What These Men Have Done You Can Do

It will not cost you a penny to learn how you too can become a Star Salesman and take your place among the big money makers of business. Whatever your ambition may be—$3,000, $5,000 or more a year—find out about this great opportunity in the wonderful profession of Salesmanship. See how the N. S. T. A. can open to you the way to a big selling job, to prosperity and a life of fascinating work, travel, contact with influential men. Just mail the coupon or write and you will receive, without cost or obligation, proof of what the remarkable system of the National Salesmen's Training Association and its FREE EMPLOYMENT SERVICE can do for you. In addition a great book on Salesmanship will be mailed to you without charge. You owe it to yourself to read of the quick and brilliant success that others have achieved and of the opportunities that await you in the field of Selling. Mail the coupon or write today.

National Salesmen's Training Association
Dept. 15-R Chicago, Ill., U. S. A.

National Salesmen's Training Association
Dept. 15-R, Chicago, Ill., U. S. A.

Send me Free Proof that you can make me a Star Salesman and tell me how you will help me land a selling job. Also list showing lines of business with openings for Salesmen. This does not obligate me in any way.

Name

Street

City

State

WANTED

Want ads for thousands of trained Automobile Repairmen are appearing in all the papers all over the Country. New Garages and Shops are badly needed everywhere. If you are earning less than $50 a week—YOU SHOULD LEARN THIS TRADE.

You Can Earn $150 to $400 a Month

Come to this school and learn. We teach by actual practice on all kinds of cars. A few weeks time learning will fit you for a position in a garage, service station, or you can start in business for yourself. (No colored enrollments solicited.)

WRITE FOR FURTHER PARTICULARS
DO IT TODAY SEND IN COUPON

BUFFALO AUTO SCHOOL, No. P S.-2
Buffalo, N. Y.

Please send me full particulars of your complete Auto Repair Course.

Name Age

Street or R. F. D.

City State

Copy this Sketch

and let me see what you can do with it. Many newspaper artists earn $30.00 to $75.00 or more per week, were trained by my course of personal individual lessons by mail. FEATURE CHARTS make religious drawing easy to learn. Send sketch of Christ Head with 6c in stamps for sample Picture Chart, list of successful students, examples of high grade and return of what YOU can accomplish. Please state your age.

The Landon School of Illustrating & Cartooning 1251 Schofield Bldg., Cleveland, O.

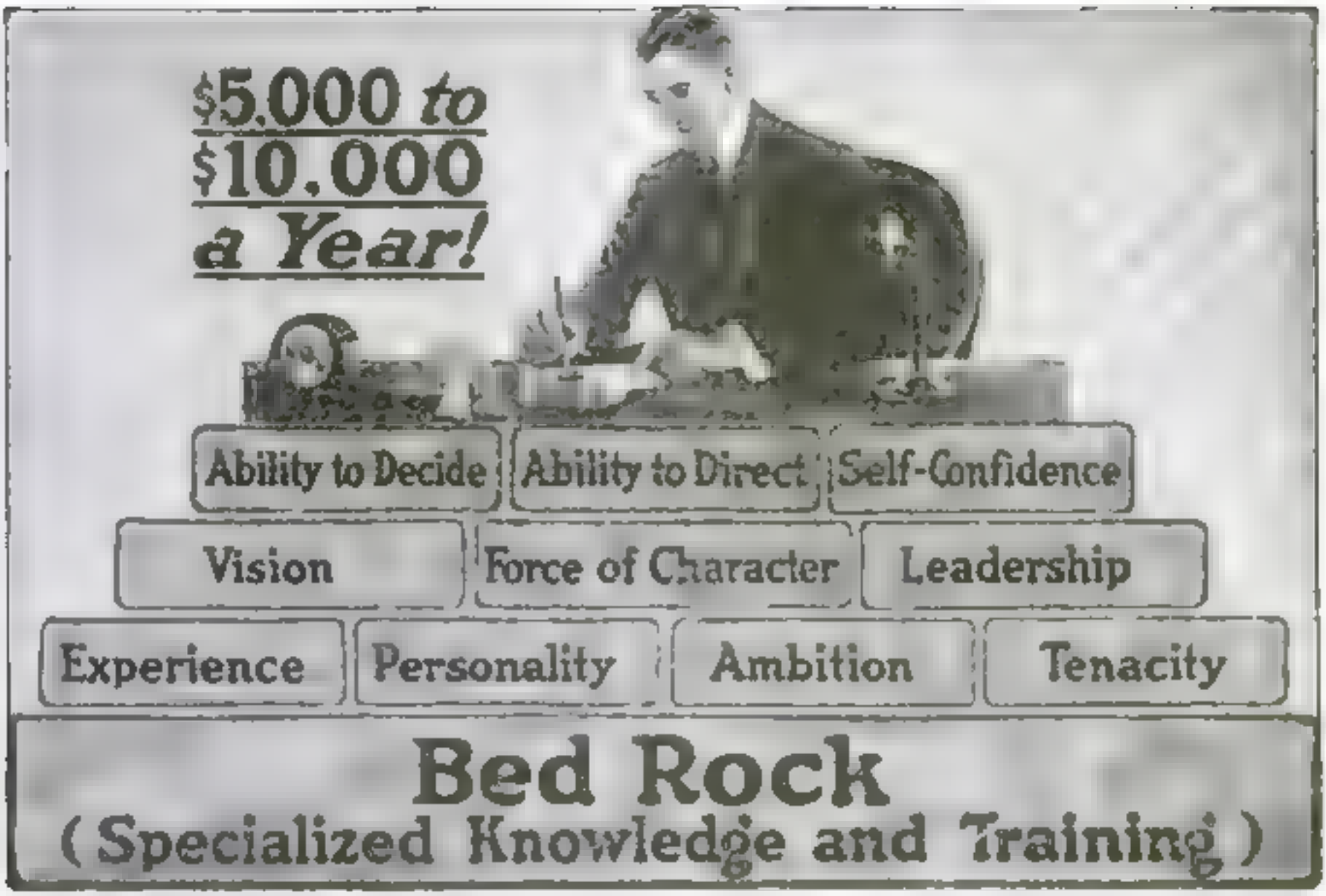
Begin Today. Write Me. BILL BROOK

F. W. Tamblyn, 432 Rialto Bldg., Kansas City, U. S. A.

Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mechanics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and run electrical machinery. Course with diploma complete

In One Year

Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. Free catalog. Write your name Dept. 29, 1300, [illegible] St. Takoma Park, Washington, D. C.



Build the Foundation for Your Success on Bed Rock

Looking out over the business district of great American cities, we sometimes wonder what the piers of steel, concrete and stone which rise from the street level and lower hundreds of feet to the rock. What is the secret of their stability? Why does not the wind and vibration of traffic, the battering of subways, the terrific impact of storms and winds cause them to totter and fall?

But the secret lies hidden in the depths of the earth, perhaps many a hundred feet or more below the street level. When the construction of these giant skyscrapers began, the first thing the builders did was to sink great piers down to *bed rock*. Upon these rest the foundations and finally the towering superstructure. Only the swerving away of the bed rock which is the very foundation of the earth itself would cause the fall of one of these great structures.

And the success of any man in the business world is just like the stability of the skyscraper. It depends upon whether or not he has built the foundation for his success on bed rock. You are just like the builder who erects great buildings. You must go to *bed rock* to build your foundation for success.

The bed rock upon which every man must build for permanent business success is specialized knowledge and training—such training as is now available to every ambitious man through the "Problem Method" of home-training which has been scientifically prepared to gather the methods of education by LaSalle Extension University.

By the LaSalle "Problem Method" of training you can acquire specialized business knowledge and training of a nature [illegible] to be of use in your [illegible] business [illegible] and business [illegible]. You are [illegible] required to develop [illegible] side of business [illegible] and then [illegible] to [illegible] them as best you can. You receive a [illegible] training that is being prepared [illegible] business executives [illegible] home. You [illegible] every kind of business [illegible] and [illegible] were on the [illegible] and at the desk of the high salaried [illegible] training to fill.

The only difference is [illegible] with actual business [illegible] company. You are [illegible] and [illegible] of the business [illegible] and [illegible] ment and [illegible] on [illegible]. All of this training [illegible] under the direct supervision of LaSalle [illegible] experts, [illegible] trained business specialists, instructors and assistants.

Day by day and after your training you have the entire [illegible] of the [illegible] at your [illegible] hand. [illegible] department of which you are a member [illegible] standard [illegible] of the high [illegible] of [illegible] each of which is yours for the asking [illegible] privileges.

On the coupon below you will find [illegible] the [illegible] by the LaSalle [illegible] Method [illegible] the [illegible] would [illegible] Mate that's one with an A. Mar the [illegible] and we [illegible] of the course [illegible] and [illegible] of the famous book "Ten Years [illegible]" [illegible] book which [illegible] how [illegible] of LaSalle training have gained in one year [illegible] such without the aid of this training have [illegible] to ten.

More than [illegible] ambitious men in all walks of business life have already been helped to get [illegible] and greater business success by LaSalle training. Over [illegible] are now being [illegible] years. It is [illegible] that of LaSalle [illegible] hundreds [illegible] men [illegible] of [illegible] and more.

[illegible] today to build your foundation on bed rock by mailing the coupon.

COUPON

LASALLE EXTENSION UNIVERSITY Dept. 1083-R Chicago, Illinois

The Largest Business Training Institution in the World

- ☐ **HIGHER ACCOUNTANCY:** Training for positions as Auditors, Comptrollers, Certified Public Accountants, Cost Accountants, etc.
- ☐ **BUSINESS ADMINISTRATION:** Training for Official, Managerial, Sales and Executive Positions.
- ☐ **TRAFFIC MANAGEMENT—FOREIGN AND DOMESTIC:** Training for positions as Railroad and Industrial Traffic Managers, etc.
- ☐ **LAW:** Training for Bar; LL. B. Degree.
- ☐ **COMMERCIAL LAW:** Reading, References and Consultation Service for Business Men.
- ☐ **INDUSTRIAL MANAGEMENT EFFICIENCY:** Training for Production Managers, Department Heads, and all those desiring training in the art of efficiency.
- ☐ **BUSINESS LETTER WRITING:** Training for positions as Correspondents, Mail Sales Directors and all executive letter-writing positions.
- ☐ **BANKING AND FINANCE:** Training for Executive positions in Banks and Financial Institutions.
- ☐ **BUSINESS ENGLISH:** Training for positions as Business Correspondents and Copy Writers.
- ☐ **COMMERCIAL SPANISH:** [illegible]
- ☐ **[illegible]:** [illegible]
- ☐ **EFFECTIVE PUBLIC SPEAKING:** Training in the art of forceful effective speech for Ministers, Salesmen, Fraternal [illegible], Politicians, Citizens, etc.
- ☐ **C. P. A. COACHING FOR ADVANCED ACCOUNTANTS:** Preparation for State Board and Institute Examinations.

Name..... Present Position..... Address.....

Do you want more money and SUCCESS

Then start on the right path of "KNOW HOW"

Mere bluff and luck may land fair jobs, but they won't hold them. Big business men today want associates who **know why** a thing should be done and **how** to do it. It's the trained man—the knowing man who climbs way up on the ladder of Success and stays there. You want to Succeed—you want the bigger income which Success brings. You can have it.

There is a fine job waiting for you to fill it

Give a few moments of your time each day to useful reading. [illegible] our [illegible]. Learn in a few short months what it has taken other [illegible] years to learn. Do it in your spare time, the time you waste now.

These books will make it easy to win

Every one of them is written in plain, easy-to-master English. Technical terms were used only [illegible]. Thousands of charts, diagrams and illustrations make the facts as plain as day. Fifty cents a week will make any one of these libraries yours, and bear this in mind—

You may have any Library for Seven Days' Free Examination

You can decide for yourself just how much good the books will do you. Send us the coupon we'll send the library you want, express collect. Use it for seven whole days, show it to your friends, put it to every possible test. Then if you can get along without it, send us the small first payment of $2.80 and balance $3.00 a month. If you decide not to keep the books, send them back to us, charges collect within the week.

Send No Money—Just the Coupon

AMERICAN TECHNICAL SOCIETY, Dept X-207, Chicago, U. S. A.

Pay Raising Books

At Greatly Reduced Prices

Carpentry and Contracting. [illegible] pictures. Was $[illegible] Now $24.80

Civil Engineering [illegible] Was $67.[illegible] Now $39.80

Electrical Engineering 6 vol. [illegible] pictures. Was $80.[illegible] Now $34.80

Automobile Engineering 6 vol. [illegible] pictures. Was $[illegible] Now $29.80

Machine Shop Practice 6 vol. [illegible] pictures. Was $4[illegible] Now $29.80

Steam and Gas Engineering. 7 vols. [illegible] pictures. Was $[illegible] Now $29.80

Law and Practice with reading [illegible] Now $49.80

Fire Prevention and Insurance [illegible] pictures. Was [illegible] Now $19.80

Telephony and Telegraphy. [illegible] pictures. Was $[illegible] Now $19.80

Sanitation, Heating and Ventilating [illegible] pictures. Was [illegible] Now $19.80

Accountancy and Business Management [illegible] Now $29.80

Drawing. [illegible] etc. Was $[illegible] Now $19.80

AMERICAN TECHNICAL SOCIETY, Dept. [illegible], Chicago, U. S. A.

Please send the set of [illegible] the special price of [illegible]. If I decide not to keep the books I will return them by express at your expense.

Name

Address

Reference

Start a Garage of Your Own. Thousands Needed. Good Territory Open

Dozens of M. S. A. S. Graduates Are Making from $5,000 to $10,000 a Year in the Garage Business

H. A. Bradley Increases His Income

From $12 a Week to $500 a Month

After Training at the M. S. A. S.

A few years ago H. A. Bradley was earning $12.00 a week as a Shipping Clerk.

Today he has a rapidly growing business of his own and is clearing this year a little over $500.00 a month.

Bradley was a man of imagination and initiative. $12.00 a week as a Shipping Clerk was not at all his idea of success.

And yet he did not know anything else. He was an untrained man. There didn't seem to be much chance for him.

One day he saw an advertisement of the Michigan State Auto School.

He read of the opportunities in the Automobile business and of the money that M. S. A. S. men are making in it.

A few days later he gave up his position as Shipping Clerk and started for Detroit.

Then followed three months of hard study and careful training and at the end of that time a good position as Service Repair man at the Oakland Motor Car Company plant at Pontiac, Mich.

He advanced rapidly because he KNEW the business. He was a trained man. The foundation for success had been laid.

Today he is proprietor of a well equipped garage and repair shop at 2349 East Fifty-fifth Street, Cleveland, Ohio, and is clearing over and above all expenses—$500.00 a month.

You can do the same as Bradley if you'll work as hard. Very little capital is required to start a garage or a repair shop. The very best of openings in good territory are awaiting you. This tremendous demand for service has been created by the use of ten million or more automobiles, trucks and tractors in the United States and Canada. In addition to the splendid business opportunities, employers in every branch of the automotive industry are calling for men faster than we can supply them. They are offering handsome salaries and quick advancement.

To get into this enormous field there is one thing necessary—you must know your business. Bradley realized this and got busy, and see where he is today. Any one can learn by our Factory-endorsed, Factory-outlined methods. M. S. A. S. has trained men from nearly every country in the world, men from every walk in life.

M. S. A. S. TRAINING covers every point of knowledge and practice required of a successful automotive expert. We teach automobiles and tractors from A to Z. Very thorough and complete training in electrics. Actual experience in assembling, block testing, bearing scraping, repairing, including cutter on Tractor training, with a real field practice on M. S. A. S. tractor farm, included in complete Auto Course. Our equipment and training are positively the best.

Brazing and welding and tire-repairing are also taught.

The M. S. A. S. can teach you how to conduct a business of your own successfully. How to repair and sell cars, how to judge used car values and give you the necessary pointers to garage management, expansion, etc. Graduates are life members with all service and advantages free. You can return any time and "brush up" on new equipment free of charge.

Think what this will mean to you.

DETROIT IS THE PLACE TO TRAIN. 94% of automobiles are made within a radius of 100 miles around Detroit, right in the city. The greatest automotive experts in the world are here, and they helped to outline our course for you. Leading manufacturers endorse and recommend our school. They have placed their machines with us for the instruction of students. They are constantly sending us students and calling for graduates. There is no training equal to M. S. A. S.

M. S. A. S. Training is a "real thing,"—and a real opportunity awaits you. Find out more about it.

Write for big free 124-page catalog and auto school monthly news. They give full particulars.

SEND THIS COUPON NOW

MICHIGAN STATE AUTO SCHOOL
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Detroit, Mich., U. S. A.

Gentlemen:—Please send me absolutely FREE Big Illustrated Catalog, Auto School News and information as checked below

( ) Auto and Tractor Course ( ) Tire Repairing
( ) Brazing and Welding

Mark each course you are interested in
Or better still, you may expect me about

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Street .....

State .....

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590 Auto Building
687-89-91 Woodward Ave. **Detroit, Mich., U.S.A.**

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225 West Thirty-ninth Street

A Crater Big Enough to Hold New York and Philadelphia

It's on the moon and it's not the largest, either

By Latimer J. Wilson

THE easiest way to illustrate the making of craters is to fry a cake of batter and watch the plastic mass as the bubbles of escaping steam burst. There, in its surface, are innumerable craters!

Look at the moon through a small telescope when the phase is near the first or the last quarter, and you will see similar circular depressions filled with shadows.

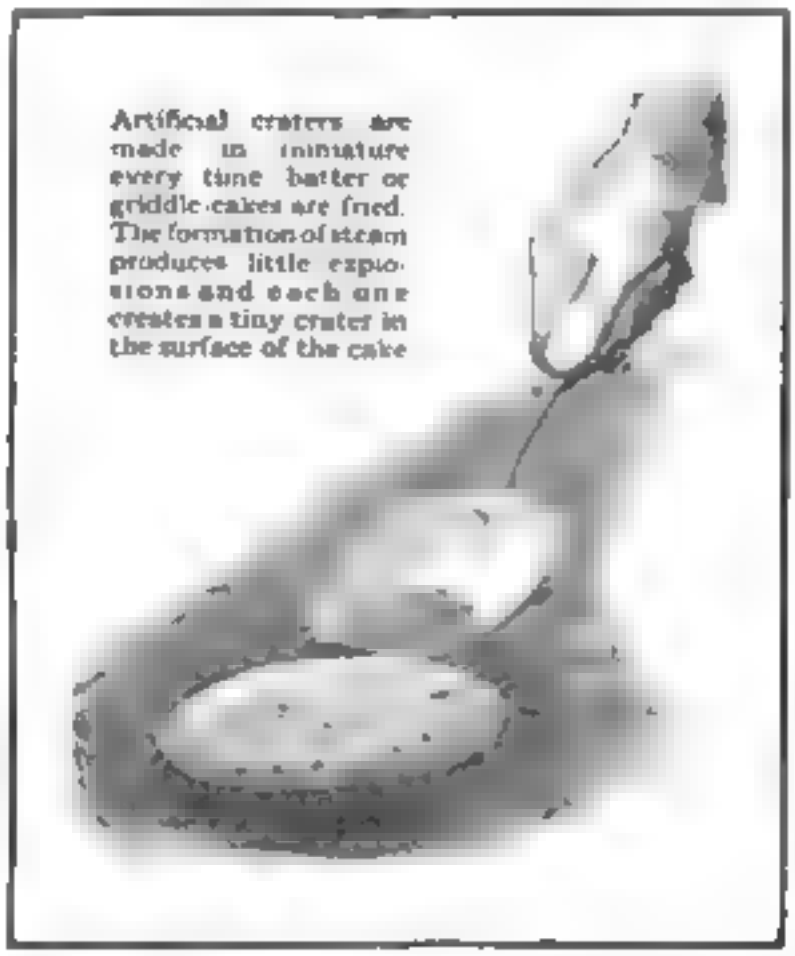
"The moon's face is pitted with holes!" exclaims the visitor to the observatory.

Then take the visitor up in an airplane and show him craters in the ground made by the shells in the devastated region of "No Man's Land." Again he exclaims

"These shadow-filled pits look like the craters on the moon!"

The comparison is certainly striking, as one can see by comparing photographs of the earth's devastated area in the battle zones with the visible hemisphere of the moon. There is, of course, the great difference in size of these formations, but the moon's craters reach beyond the hundred mile mark in diameter, while the largest earth-crater does not reach a diameter of fifteen miles. The explosive violence necessary to produce such gigantic formations would be required to increase their force manyfold before such depressions could have even been formed on the earth, because the force of superficial gravity on the earth is six times greater than that on the moon.

The moon's atmosphere during the period of the shaping of lunar scenery must have been a negligible factor to offer resistance to the volcanic forces of propulsion. It has been calculated that with the lessening of atmospheric medium of resistance, and with the lesser superficial gravity, volcanic eruptions on the moon could have formed the ringed walls of the lunar craters on the huge scale we now behold them.



Artificial craters are made in miniature every time batter or griddle-cakes are fried. The formation of steam produces little explosions and each one creates a tiny crater in the surface of the cake

If all of the lunar circular formations had conelike peaks in their center, and if the opening, or chimney through which the erupted material was ejected, could be seen, there would be little hesitancy in saying that all of the moon's formations were the result of volcanic activity on a gigantic scale. But some of the craters have no central cone, and as yet no telescope has shown the vent in any of the central peaks through which ejected matter could have been thrown, though there are small craters near the center of large ones. Many of them are great circular plains walled in by high mountains.

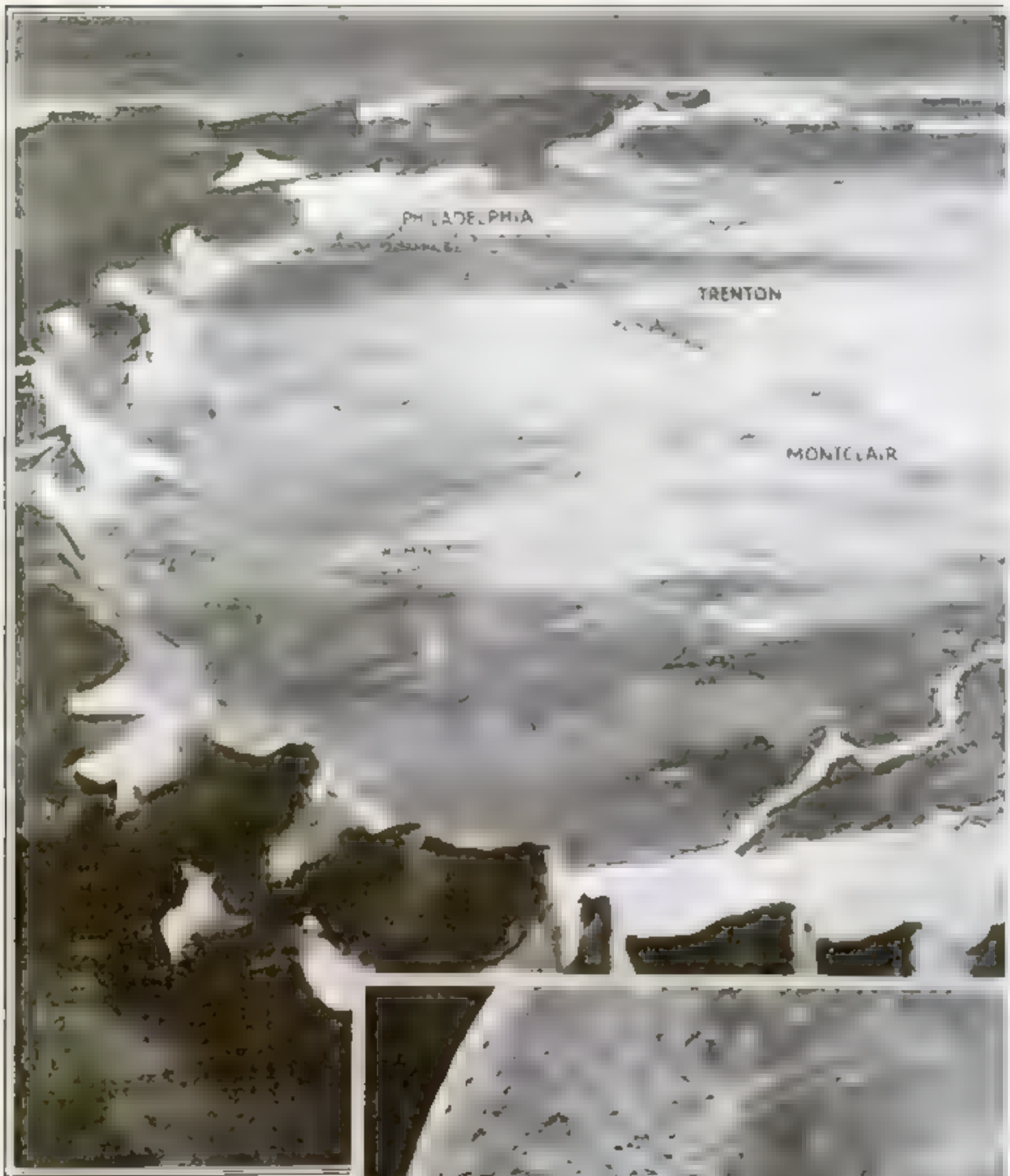
What a fantastic picture the moon must have presented in the days of its crater-making! In the frigid region of space through which the planets move, it must have cooled comparatively quickly. Projectiles of solid matter, rock and metallic fragments must have been fired into the sky with enormous force. Some of these particles fell back upon the moon and piled up lofty mountain rings. Other masses, perhaps, were sent outward in such a manner that they became distinct bodies which even to the present time swing around in the solar system in orbits of their own. Possibly some of the bolides, the meteorites that flash with explosive force into the air, are fragments of early lunar volcanic activity. How fantastic the idea of our being able to lay hands upon one of the huge iron meteorites in the museum and to say, "Perhaps this heavy mass is a part of the moon!"

Take a "close-up" view of one of the moon's vast formations. Near the center of the hemisphere that faces the earth are several of the largest. One of these, about one hundred miles in diameter, has no central peak, but consists of a surrounding wall of mountains. There are small blowholes to be seen upon the floor of this circular plain.

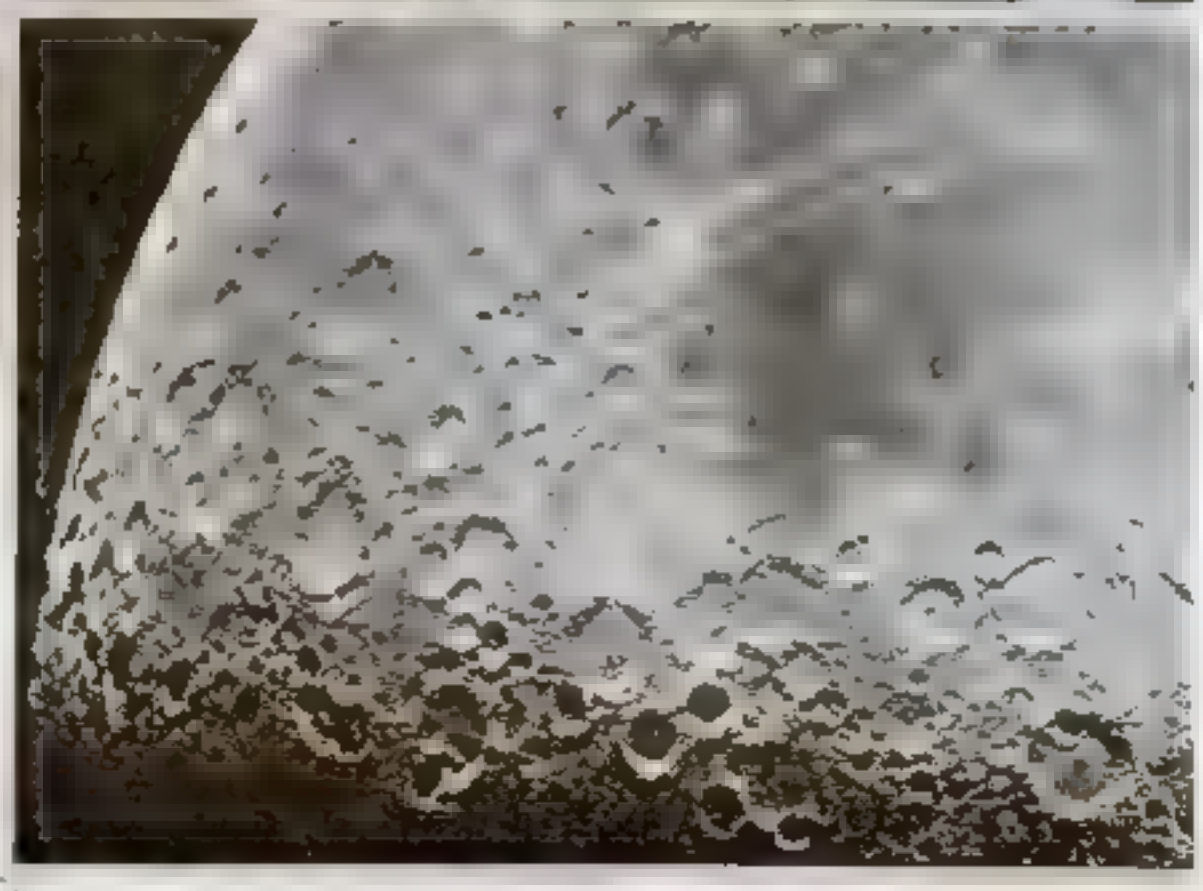
Now, if we picture this great ring of mountains on the earth, the city of Philadelphia could be built at one side and the whole of New York at the other, with the country between.

The pictures on the following pages give a clear idea of this.

This moon crater is large enough to accommodate



Redrawn from a film photo [illegible] for the library page

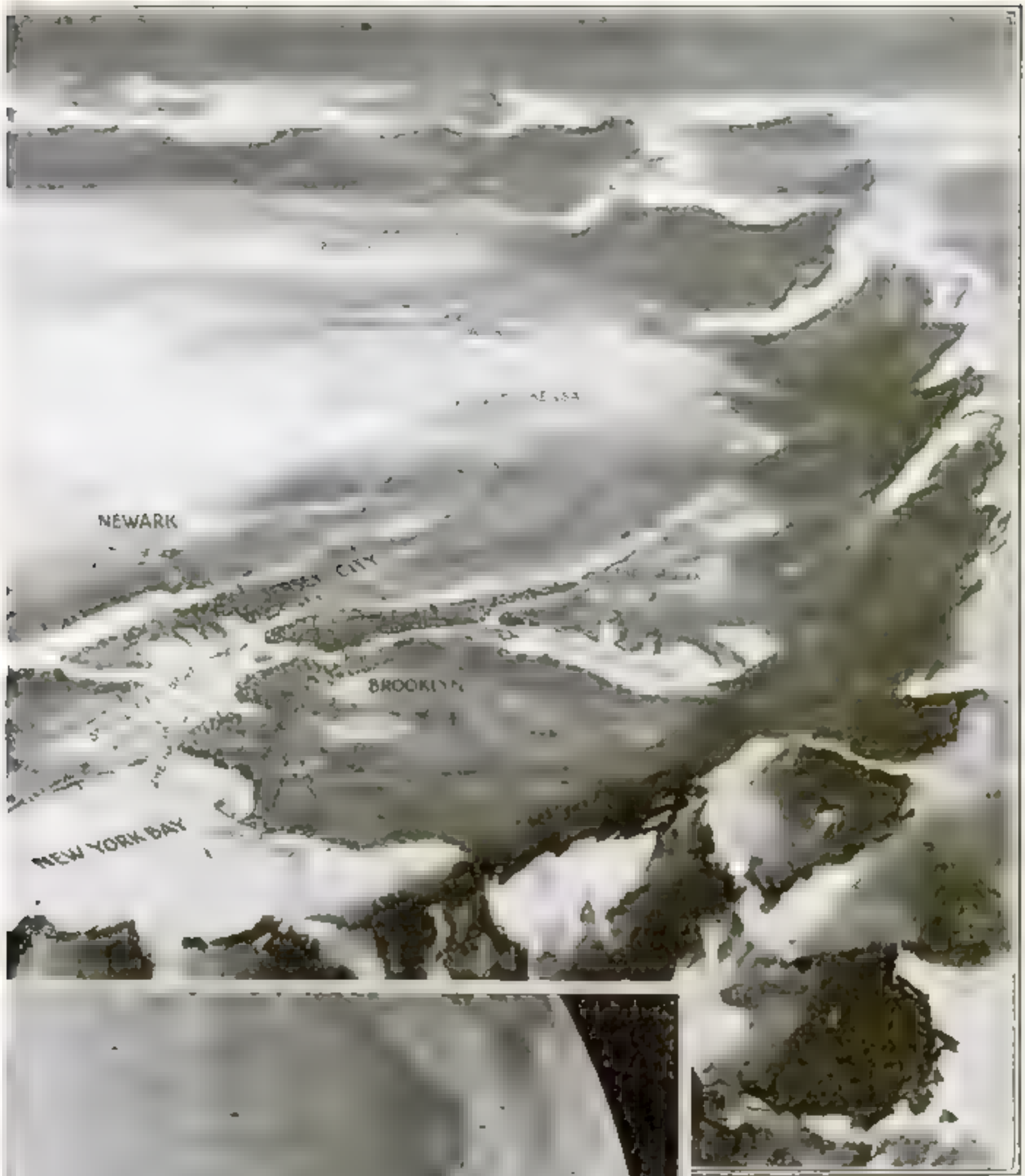


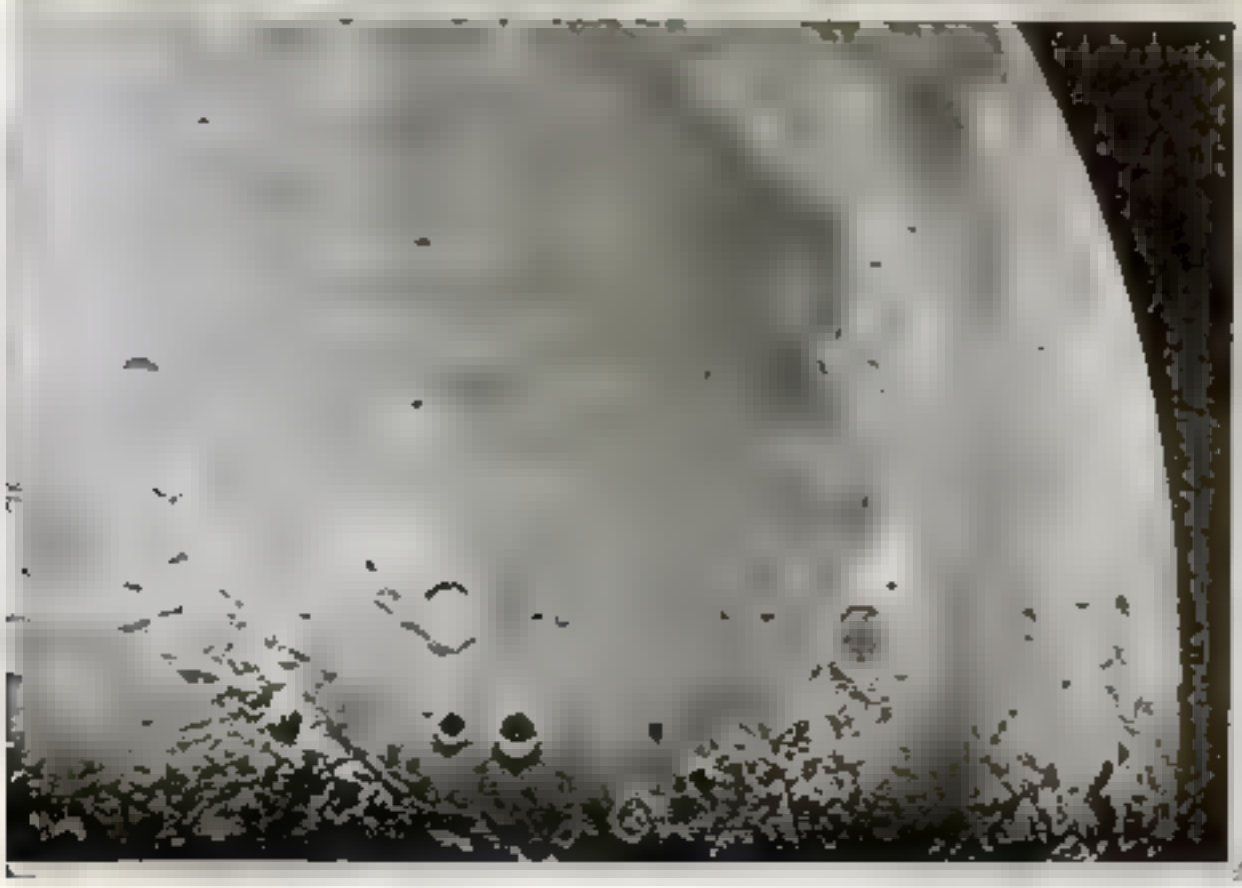
In the excellent photograph of the moon shown at the right, made through the world's largest telescope, the white arrow points to a crater which is more than one hundred miles in diameter.

The cities of Philadelphia and New York, with their suburban districts and neighboring territory, can be included easily within the domain of this giant crater, as the drawing above shows. Imagine taking a train trip across the floor of such a gigantic formation. Only in this way is it possible to obtain an idea of its size.

Photograph by Mount Wilson solar Observatory

New York, Philadelphia, and the country between





Photograph by Mount Wilson Solar Observatory

The surface of the moon is seen literally pitted with craters, ranging in size from mere blow holes a few hundred feet in diameter to huge circular formations extending over a hundred miles across.

In the photograph can be seen the most prominent mountain range on the moon, its highest peak rearing the lofty altitude of more than 16,000 feet. What a remarkable sight would greet a person who stood upon the rim of mountains surrounding a large crater and looked across the valley, watching the sunrise upon the distant peaks!

The Undying Lure of Perpetual Motion

Like truth crushed to earth, the old, old fallacy rises again. Here we tomahawk it once more

By Philip Rowland

IN the early middle ages the *perpetuum mobile*, which means "an everlasting moving thing," or, with a slight stretch in correct translation, "a thing that moves forever," was launched upon a long but inglorious career by philosophers who knew Latin better than mechanics or physical science. The problem that the phrase was supposed to represent took hold of the imagination somewhat as did the other two problems, known as the trisection of an angle and the squaring of the circle, which also date back to antiquity.

It was not easy to prove that these problems cannot possibly be solved, and therefore are not problems at all, because those who were willing to tackle the problems were not sufficiently gifted to understand the proof of demonstration. Never being solved, the problems drifted down the corridors of time, and the interest in them spread from those with a smattering of learning to all classes of the populations of Europe.

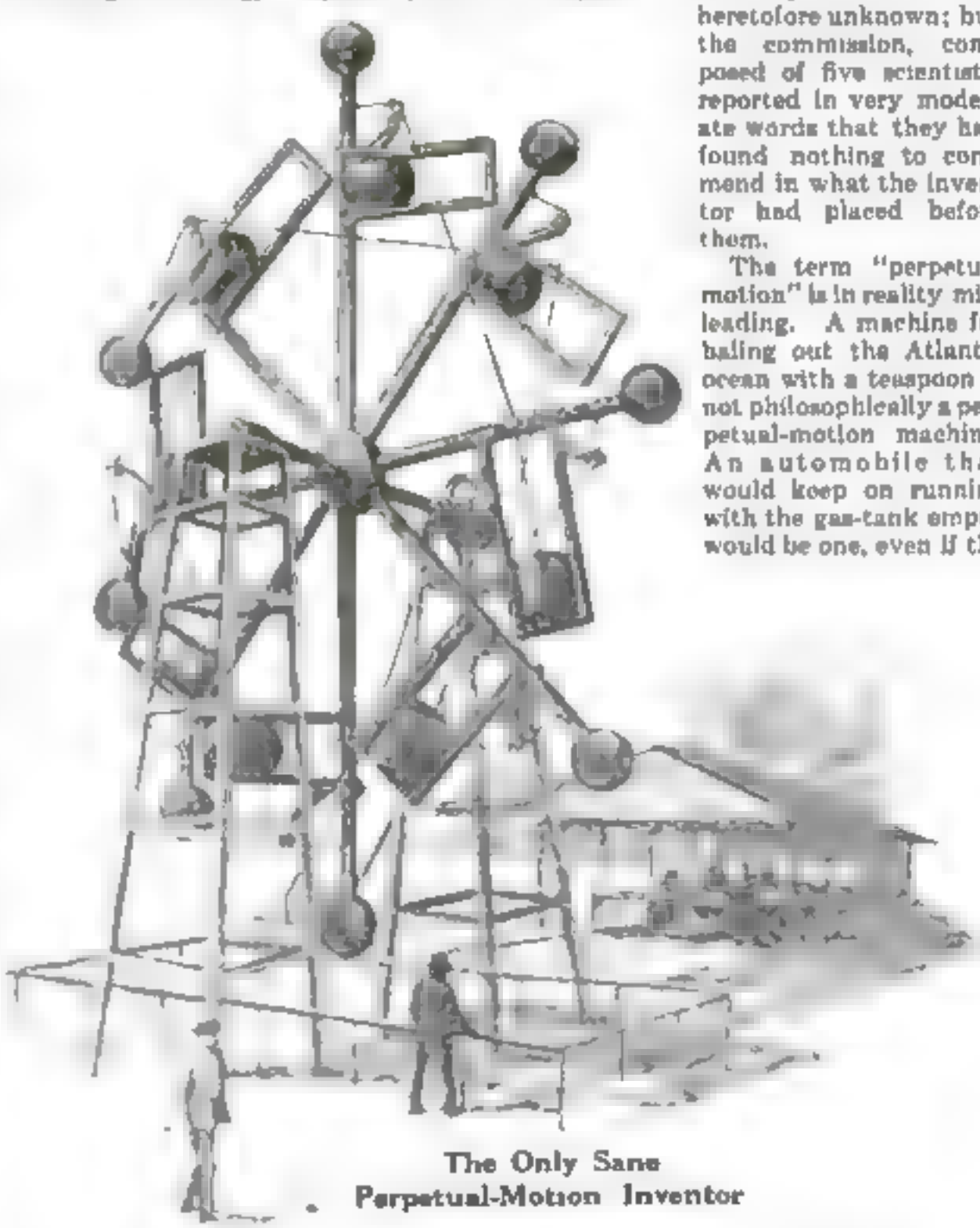
The impossibility of solution advertised the problems. The problems in geometry never became so popular, of course, as that of perpetual motion, which any mechanic or amateur could hope to solve by inspiration, and for the solution of which it was rumored kings and governments and princelings had offered huge rewards.

Owing to its origin among philosophers who cared more for the principle than for practical utility, the perpetual motion idea was started in a bad groove of thought. It was considered sufficient to make a little toylike thing, a tiny machine, which, once started, would keep on running, overcoming its own friction resistance but doing no useful work otherwise.

If this could be done, it was held, a large machine constructed on the same principle would be certain to do much more. It was overlooked that the hapless enthusiast who started out on this plan, aiming only for a very slight surplus of power to operate the chimera, would be dealing with forces too small for measurement by any ordinary means and would be likely to delude himself at every step with over-hopeful guesswork in favor of the scheme he had once adopted as a promising one. The germs of failure by reason of their microscopic dimensions would remain hidden to his not overly sagacious mind, just as the bacilli of disease, being invisible to the naked eye, escaped the attention of the medical profession far into the middle of the nineteenth century.

As late as 1917 a great stir was made over the so-called Garabed machine, which nobody but the inventor had seen, but which was represented as capable of turning a shaft continuously without using fuel, thereby creating free energy. Special protection was granted for this invention by Congress, and an investigating commission was appointed to take due note of what there was to protect. It was not made clear whether the Garabed was really to be classed as a perpetual-motion machine or was intended to draw energy from the atmosphere in some mysterious manner heretofore unknown; but the commission, composed of five scientists, reported in very moderate words that they had found nothing to commend in what the inventor had placed before them.

The term "perpetual motion" is in reality misleading. A machine for baling out the Atlantic ocean with a teaspoon is not philosophically a perpetual-motion machine. An automobile that would keep on running with the gas-tank empty would be one, even if the

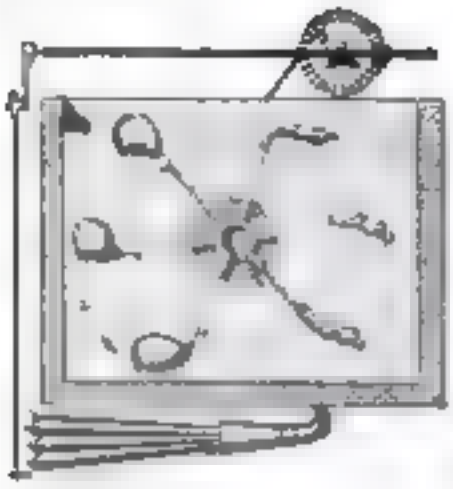


The Only Sane Perpetual-Motion Inventor

James Ferguson, a fellow of the Royal Society, devised this machine—but for the laudable purpose of laying bare the utter fallacy of perpetual motion.

Jointed spokes with heavy balls at the ends radiate from a horizontal shaft. To each spoke is secured a rectangular frame in which a weight slides. It is clear that, as a spoke swings down to a horizontal position, the weight in the frame drops, pulling straight out by means of a cord, as it does so, the ball at the end of a spoke. As the spokes swing around to the left the weights in the frames drop back and cease pulling, so that the spokes bend at their joints, and the balls at their ends move inward.

Says Ferguson: "As the balls or weights at the right hand side are farther from the center than they are at the left, it might be supposed that this machine would turn round perpetually. But whoever makes it will find it to be only a mere balance."



"Worked" by Buoyancy

A hollow shaft, hollow arms, weighted bellows at the ends of the arms, screw-valve throttles in the arms superfluous, but showing how the inventor tussled to get it all just right.

The bellows enter the water compressed by the weights, the opposite bellows receiving the air through the arm and expanding to make room for it, its expansion giving them buoyancy to turn the wheel.

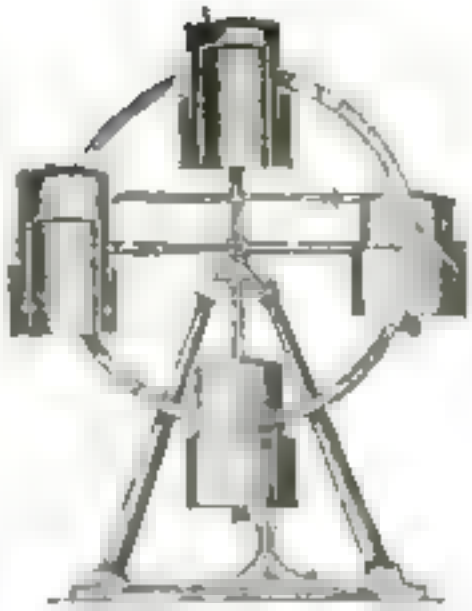
It is not a high speed engine, due partly to the resistance of the water and partly to the fact that it requires more power to expand the bellows under water than can be recovered by buoyancy. Each expansion must drive the water a little higher in the tank.

It Stopped When the Power House Did

A bold hoax publicly uncovered is the most useful form of perpetual motion. This photograph shows the same kind of wheel on which the Marquis of Worcester, in 1646, wrote a learned book under the title, "An Advantageous Change of Centers."

This wheel was erected over a roadway in Los Angeles. It revolved slowly all day and all night, and the ostensible motive power was a series of metal spheres that ran out quickly to the circumference on the straight side of the spokes and came back slowly on their curved side.

One day, when the electric power plant of the city shut down for a repair, the device stopped, for lack of motive power, and the mystery was solved.



He Tried a Vacuum

Having perhaps perceived the futility of manufacturing buoyancy under water and then trying to utilize it with a net gain, this inventor tries the same scheme with air.

The cylinders, which have mercury packings to reduce friction, are arranged by means of communicating valves to have a vacuum on one side of the wheel and air on the other.

The difference in weight between a vacuum and air is all this modest man wants to operate with, but he dreams of condensing the air to enhance the efficiency of the machine.

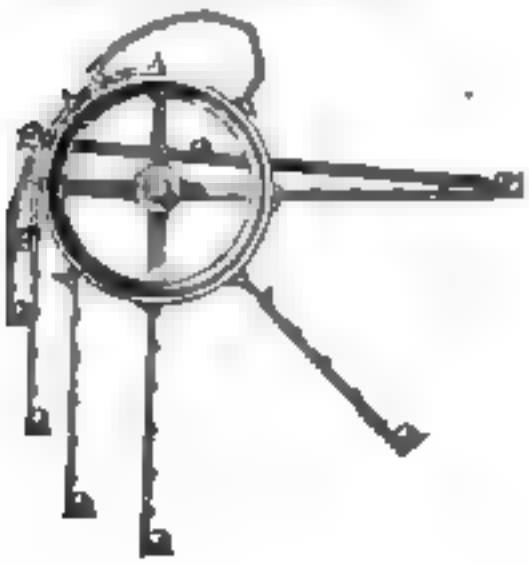
Levers and Balls

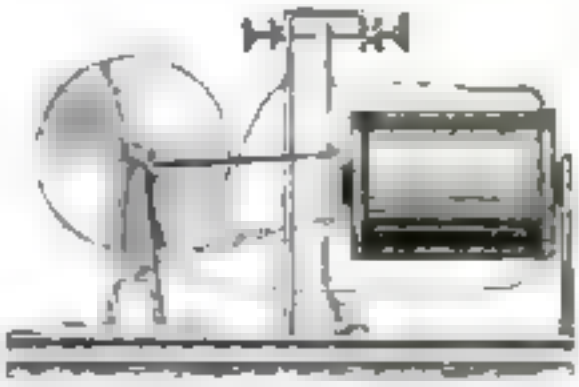
Imagine a series of wheels of which that shown below is one. One lever is in the act of falling from the periphery of the wheel into the right line.

Note that the lever is composed of a series of jointed flat rods, provided with a stop to prevent their collapsing at any time more than enough to bring any one of the rods at a right angle with the rod next to it.

The lever is hinged to the periphery of the wheel in such a way as to prevent its falling into any other than a right line from the center of the circumference of the wheel.

Each lever has a bucket at its outer extremity, the bottom being sufficiently broad to retain a ball. The balls are supposed to roll out upon the inclined plane and roll to the other end, ready to be taken again into the buckets.





The Electric Mystifier

The frictional electrical machine is started, magnetizing the temporary magnet and drawing the armature toward it. This breaks the circuit, demagnetizing the temporary magnet and allowing the spring to close the circuit again.

Says the inventor: "If a magnet of a certain power will not move the electric plate, its power could be increased without decreasing the resistance which the magnet and conductor offer."

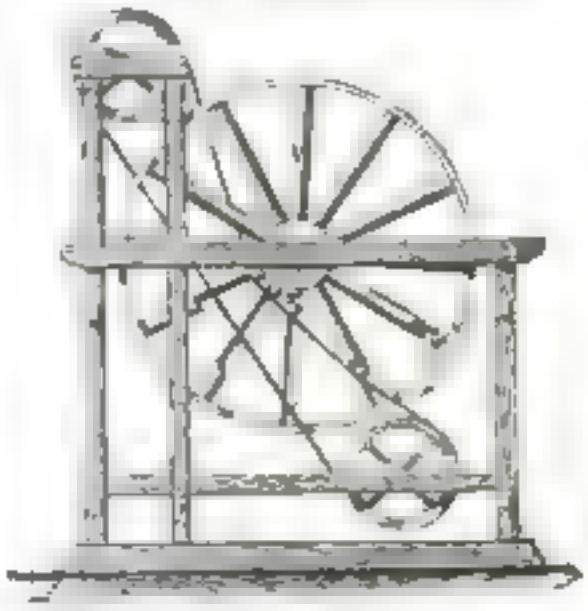
The Eccentric Weight

Here is the old eccentric-weight idea. The wheel has twelve hollow spokes, in each of which is a rolling ball. The belt passes over two pulleys.

In order to allow the belt to pass freely and meet the balls, there is an opening around the wheel from hub to circumference.

The balls are met by the belt as the wheel revolves, and are raised from the circumference until they are at last brought close to the hub, where they remain until, by the revolution of the wheel, they roll out through the circumference.

Thus the balls are on one side of the wheel, always at the circumference, so that that side is heavier than the other, which causes the wheel continually to revolve.



"To Roll Along . . . till Time Shall Be No More"

Here we show a railway carriage, self-moving, invented in 1829. The inventor had read everything about the fallacious machines already made, but his would "assuredly, if given a path encircling the earth, continue to roll along in one undeviating course till time shall be no more." The conical wheels permit the carriage to ascend a rising track without raising its center of gravity

tires and gears eventually wore out. A perpetual-motion machine is one that produces power by means of something that consumes power. It has been defined by a famous physicist as "a machine whose movement creates power to continue the movement." There is always creation involved in the work it is supposed to do, and creation is not observed in any other machinery

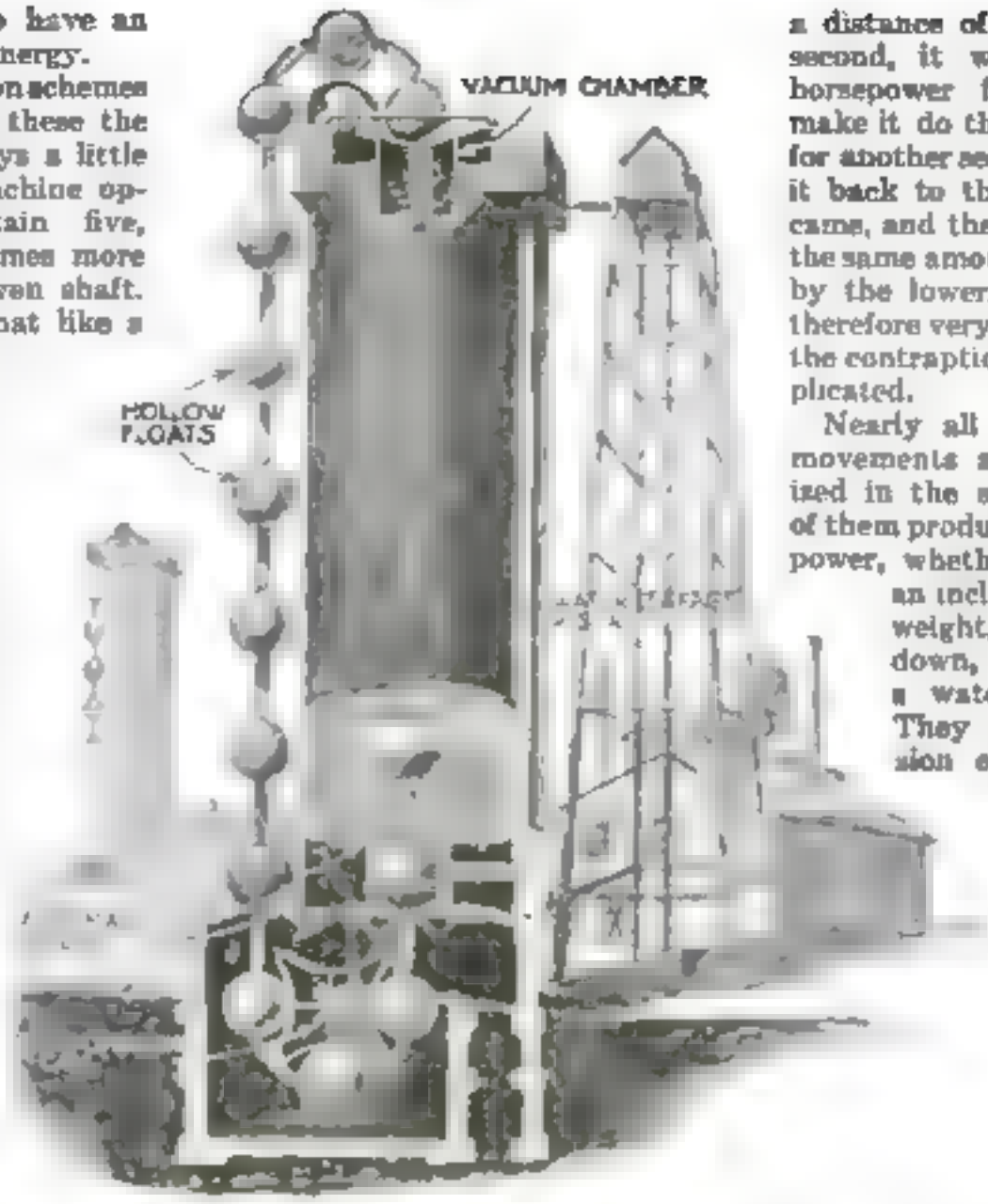
Any work, be it ever so small, foots up, when continued for a long time. It can always be measured in foot-pounds. The power necessary for doing it can always be measured in foot-pounds to the second. One horsepower equals 550 foot-pounds a second, and some security against perpetual-motion schemes would be established if those who support them would learn to insist on having at least 550 pounds raised one foot a second by the promising machine, and having this done for 3600 consecutive seconds without any help from outside sources. One horsepower for one hour is not too much to ask

of a person who claims to have an inexhaustible mine of free energy.

The veiled perpetual-motion schemes are the most insidious. In these the inventor deliberately employs a little real power to make the machine operate, but claims to obtain five, twenty, or one hundred times more power from it at the driven shaft. Such a machine is somewhat like a puppy wildly chasing its own tail. If it could ever catch it, the chase would stop. In the bogus machine, if the driven shaft, with its fictitious surplus of power, is geared back to the driving shaft, to take the place of the small but real power, everything stops. A very celebrated perpetual-motion engine was of a similar type. Professor Gamgee, of London, obtained a United States patent on it in 1881, and made great commotion with his invention in industrial and scientific circles. He used anhydrous ammonia, which boils at about 34° Centigrade, instead of water, in an engine similar to a steam-engine. From a boilerful of liquid ammonia, which would develop a high pressure at ordinary temperatures, he figured on sending the vapors into compound cylinders to expand against pistons. By the expansion the vapors would cool down to very low tension and in this state they would be exhausted into a receiver, further exposed to cooling, and thence led back to the boiler, whereafter the cycle of operations should begin again.

The Patent Office and the Navy Department approved of the plans, but it was not found possible to make any gain by first expanding the substance by evaporation and afterward condensing it sufficiently to get it back into the boiler against the pressure there existing, it being nature's law that condensation generates as much heat and pressure as can be gained from expansion. Yet the scheme seemed plausible if the high-pressure boiler and the condenser could be kept at very different temperatures.

In many of the true perpetual-motion devices metal balls are depended upon to roll from one part of the mechanism to another and thereby produce motion of the machine parts against a resistance. If such a ball weighs 550 pounds and is made to carry a lever vertically downward for a distance of one foot and in one second, it will produce nearly one horsepower for one second, but to make it do the same thing over again for another second it is necessary to get it back to the height from which it came, and the raising will require just the same amount of work as was gained by the lowering. These devices are therefore very childish. In recent years the contraptions are always more complicated.



It is clear that buoyancy is to make the machine run forever. Complicated chambers are provided for the entrance and exit of the floats to and from the tanks, but the underlying notion of buoyancy is fallacious and fatal. Buoyancy is not inherent lightness in the floats, but a lift action pure and simple

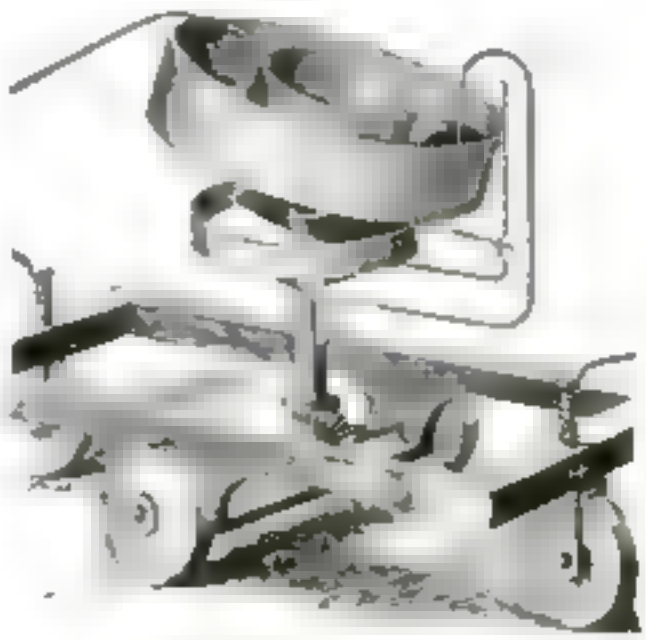
Nearly all the known mechanical movements and expedients are utilized in the same machine, and each of them produces resistance and wastes power, whether it is a gear, a lever, an incline, a magnetic clutch, a weight, or a float going up and down, a rocking beam, a pump, a water-wheel, or what not. They are all power-transmission elements but not power producers, and all operate with a loss.

But the more there are of them the easier the inventor can delude himself and others, until it comes to showing the machine working. The machine makes no argument. It simply refuses to work.

This is the one great characteristic feature which all perpetual-motion machines have in common. A number of them are illustrated herewith. Their best value lies in the mental exercise required for pointing out their fallacies in detail.

When defining what is understood by perpetual motion, it is necessary to exclude all plans for taking heat or motion or electric current from the forces that are active in nature or that may be generated from materials as long as these materials last. A clock, operated by the exceedingly weak current from a small quantity of radium salt or from a dry electric pile, may be kept going for a very long time, as the power required is almost infinitesimal; but if the same sources of energy were to be used on a scale that could be considered for power purposes, they would be found uneconomical and the materials would quickly be worn out.

Among the natural forces that may be counted on indefinitely, changes of temperature from day to night and changes from barometric pressure have in several instances been employed for producing self-winding clocks and similar unimportant toylike contrivances. But these are not perpetual-motion machines, since the power operating them is well understood and is not used generally because it cannot be used conveniently on a large scale.



Listen to Dr. Drasch

"This invention consists in the arrangement of an annular tilting tray, which forms the orbit for a revolving ball, in combination with a supporting platform, and with a lever which extends into the tray [illegible] connects with a shaft, to which motion is to be imparted in such a manner that, by continually changing the position of the tray, the ball is caused to rotate therein without interruption, and by the action [illegible] the rotating ball on the lever, the [illegible] motion is imparted to the shaft in connection with the working machine or mechanism to be driven."

Is it all perfectly clear now?

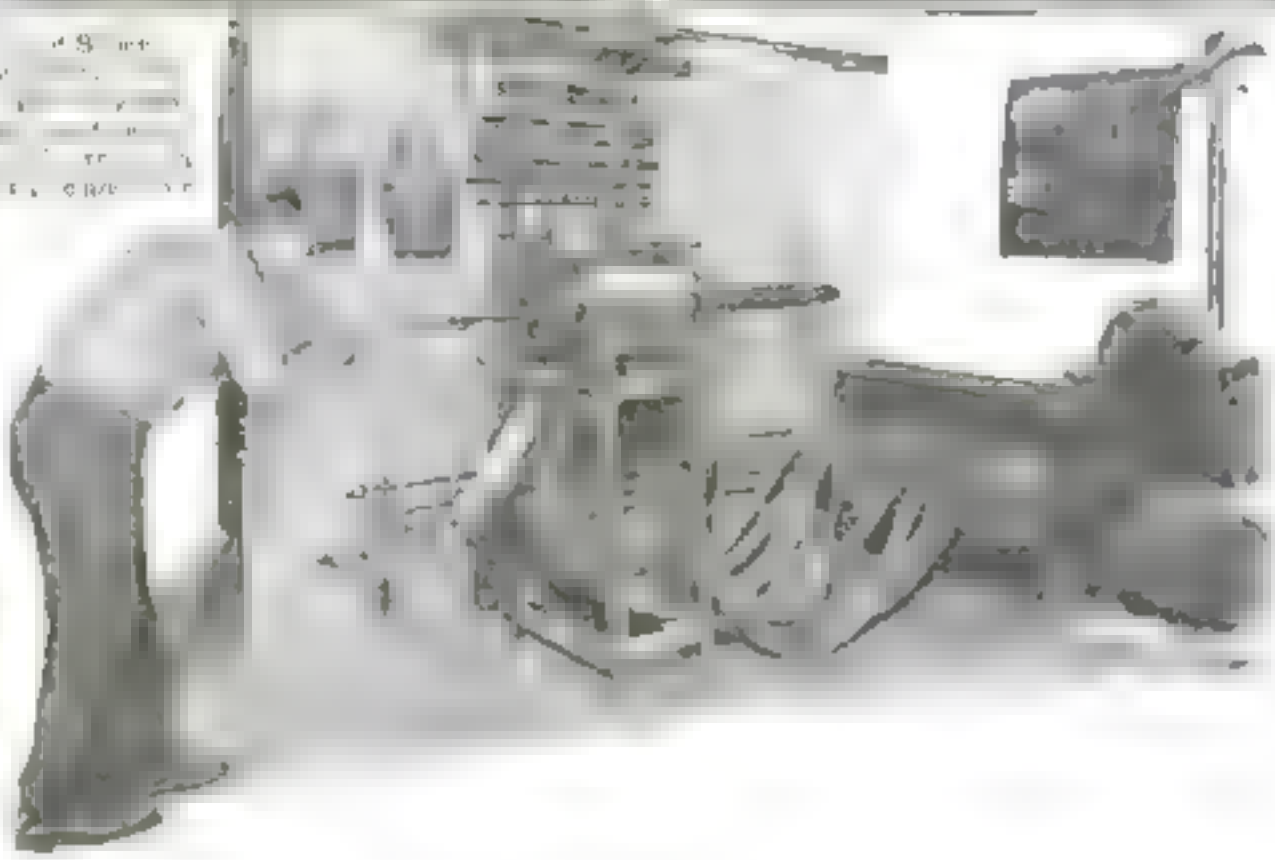
Saving Billions by Research

If it were not for research we might still be burning the old carbon-filament lamp

Since tungsten was discovered, in 1781, it was held to be unworkable. After much research, a method of working it was discovered. Now it can be drawn into fine hair-like filaments. This woman is drawing tungsten rods through diamond dies to make lamp filaments

In the picture above, from left to right, you see tungsten ore, the same ore crushed to powder, then oxidized to pure tungsten, and finally in bar form, from which the fine wire is produced. Much experimenting was necessary before the tungsten could be made ductile

as the old carbon fila ment lamp



ably the hottest place on earth

liquid air

The Best Way to Do It

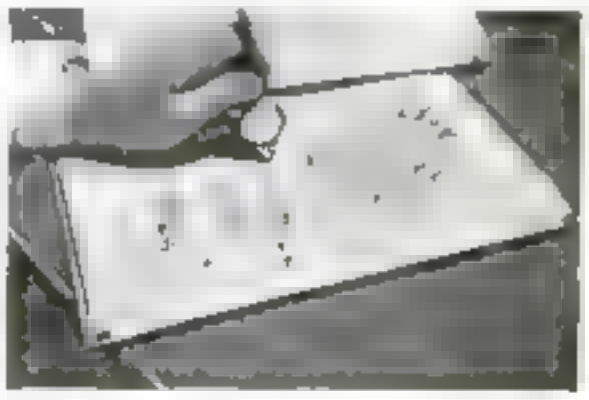
Major Frank Gilbreth, the noted efficiency engineer and motion-study expert, demonstrates the one best way

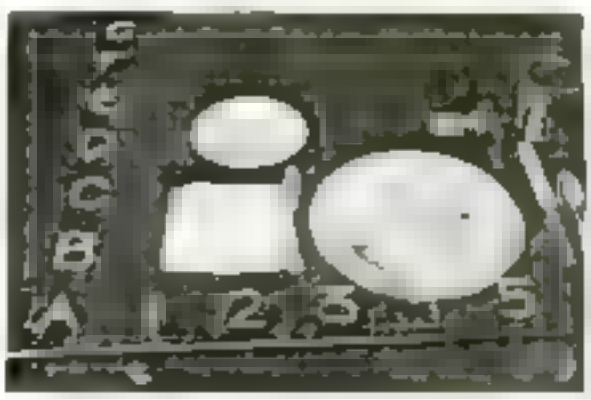
All the motions of changing the paper in a typewriter were charted and [illegible] laid out on the visualization board. One set [illegible] the set represents the [illegible] motions. By [illegible] these components [illegible] blind person can learn to work as rapidly as a good typist who has her eyesight to aid her

Here Major Gilbreth, blind [illegible] is [illegible] strings, his visualization board [illegible] for helping blind people at lectures. By means of strings and thumb-tacks fixed at various intersections of the grooves in the board, the blind man can follow the lecturer [illegible] as people with their sight follow [illegible] by watching a blackboard diagram

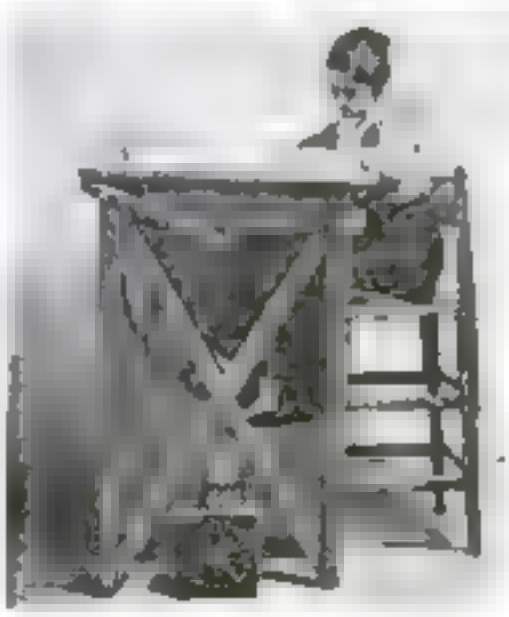
These lines are the learning curves of three persons. They were told to write their names, omitting every other letter, and they did it twenty times before they approximated their customary speed

These maps and pins represent the route taken in a certain office by documents, bills, etc. The carriers follow the lines laid out, that after many tests have been adjudged the shortest, and their output is materially increased





A blind man's dinner-table ought to be charted and each utensil should be put in the same spot from meal to meal. This will enable the blind man to find them without fumbling, as soon as he learns their positions



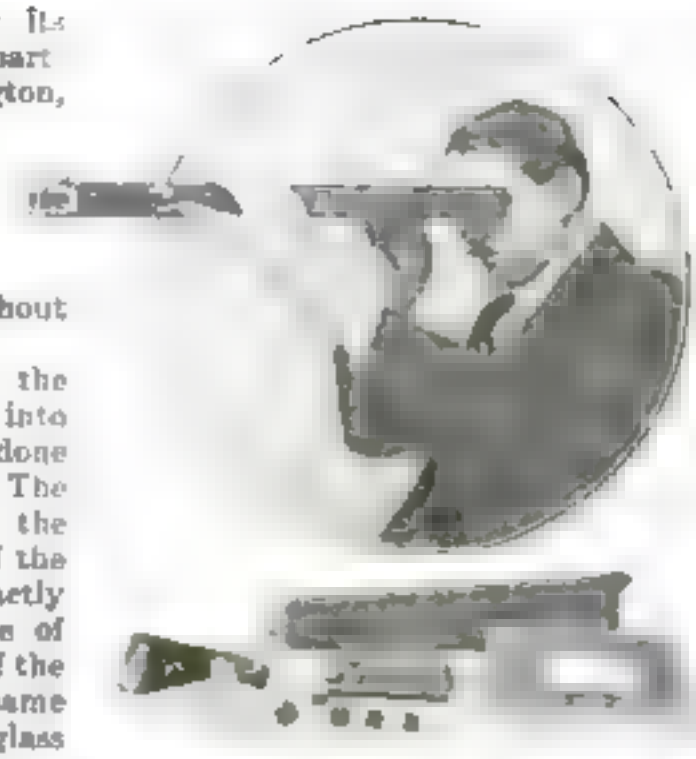
You can either stand or sit at your work if you use a Gilbreth desk. Pictures of it appear at the left and the right. It reduces fatigue to stand occasionally, and your efficiency goes up if you reduce fatigue. Comfort is essential to good workmanship—particularly when one works at a desk all day. This desk and chair were built for comfort. Whether sitting or standing, the writer's arms are in the correct position. You will notice that the back of the chair slants forward and that the foot-rest underneath the desk is curved

Grading Rosin by Its Blush

ROSIN can be classified by its blush! Experts in the Department of Agriculture, Washington, D. C., have developed a "comparison-box," which accurately compares the blush of a piece of rosin with that of a piece of colored glass. It is possible thus to grade rosin rapidly, without physical or chemical test.

Before rosin can be tested in the comparison-box, it must be cut into the proper sized cube. This is done with a small adze or hatchet. The cut rosin is then mounted in the comparison-box next to a piece of the colored glass. If its color is exactly the same as the glass, the grade of the rosin is known immediately. If the piece under test does not have the same color as the glass standard, the glass is changed until a piece is found corresponding with the rosin under test.

When the comparison-box is used, it is pointed skyward, and, to insure uniform light, a piece of translucent white paper or film is placed between the sample under test and the light.



Testing rosin with the comparison box, obviating a chemical analysis. Below is the comparison-box, with a few samples of rosin to be tested, and the standard colored glass screen with which the rosin is compared

An Apartment-House for Plants

PEOPLE live in apartment houses, so why shouldn't plants? So queried Walter Gouinlock, of Toronto. Whereupon he invented an apartment greenhouse.

The greenhouse is so made that it backs up against a hill, as shown in the illustration.

Any desired number of floors can be built, but they recede as they go higher up. In the basement there is a heating plant and a reservoir. Pure air from outside enters the basement through a pipe. It is heated, and then moistened by the water in the reservoir. It passes through an opening next to the glass wall, and heats the various apartments in turn, passing off through a ventilator in the roof.

The rear end of each apartment is against the hillside and therefore it is rather dark. Not wishing to waste heat on these dark places, Mr. Gouinlock provides a non-heat-conducting curtain that cuts off the rear. The dark rooms may be used for growing mushrooms or for housing roots.

This greenhouse is really an apartment house for plants. There are several floors and they are all heated and moistened by one heating plant and reservoir in the cellar

He Made a Profession of His Hobby

William Richards has been building ship models all his life

By Herbert Asbury

BEING a Boston boy, William Richards was only eleven years old when he read "Treasure Island," and he was immediately filled with a great craving for adventure upon the high seas, and for battle with pirates over golden treasure. But being a Boston boy—he realized very quickly that there were certain obstacles in the way that were apt to prove insurmountable, so he put aside for the time the craving for travel and adventure, and centered his ambition upon a ship. He must have a ship. So he went to his father.

"Dad," he said, "I want a ship."

"Then build one."

That was final, and it settled matters as far as the purchase of a natty, trim-rigged little ship was concerned. William Richards knew that the only way he would ever get a ship would be to build it, unless he wanted to waste the summer doing errands. So he got out his tool-chest, sharpened the tools, and in the back yard there was great industry, with much sawing and hammering and smashing of fingers.

As a boy, William Richards asked his father for a ship, and was gently but firmly referred to his tool-chest

But the day came finally when he went to the pond in Boston Common and placed on the water an amazing collection of bits of board which he fondly called a ship. He gave the ship a push and watched it eagerly, when the ship wabbled uncertainly and then tipped up and went down by the stern. It had sailed for probably five seconds.

But young Richards was not discouraged. He fished up his vessel, went home, and set to work on another ship with the indomitable perseverance of a Sir Thomas Lipton.

Richards' second ship was more successful. It sailed proudly on the somewhat muddy waters of Boston Common pond—and one of America's greatest ship-modelers had started on his career

Every summer after that William Richards had a new fleet of ships, some of them amazingly original in design, but all of them seaworthy as far as the seas of Boston Common were concerned. He has been building little ships ever since, and his reputation has increased, so that now the word of William Richards comes very near being the law as far as models of ships are concerned.

For many years Richards made ships merely as a hobby, but recently he went into it as a profession. He has an office and workshop down an alley behind a tenement-house in the Bronx, in New York city, and there he makes his ships.

He makes all kinds of ships, and his establishment is probably unique in the United States. There are, to be sure, other men who make ship models; but not only are there very few who make as fine models as those of Richards, but there is none, as far as he knows, who does exactly the same sort of work. He makes ships for the big shipbuilding companies, models made to scale that are used as silent salesmen. But the important part of his work, the part that he loves the most, is that which he is doing to interest the boys of the United States in the Merchant Marine and in the navy.

Every boy likes to build ships and things. Almost any boy would rather have a vessel of his own construction, no matter how crazily it floats, than the best machine model that money can buy. But there are certain parts of the work that the average boy cannot do, and it is to overcome this trouble that Richards has devoted a great deal of his talent as a ship-modeler. A large part of his time now is devoted to the construction of partly finished models, to be finished by boys who have a knack for that sort of thing. He makes them in various degrees of completeness, so that a boy of any age can find something in Richards' models that he can handle all the way to the finished craft.

Richards has worked for many years developing his system of partly finished models. He has so developed his system that those who have never attempted to design or build technically correct model yachts may, by using his drawings or the glued-up blocks sawed to shape inside and out, produce a correctly proportioned, accurately designed model which will sail and handle in the same manner as the large boats from which the model is designed.

It might be thought that these partly finished models are used entirely by boys, but this is not always the case. Richards is fond of telling about the New York stockbroker, a man of wealth and big business interests, who came to him one day and wanted a partly finished model.

He pointed to the six-foot hull of an unusually complicated ship model and said that would be about right for his twelve-year-old boy.

"A twelve-year-old boy never could finish that ship," said Richards. "You had better get him something simpler."

"Well," grinned the broker, "to tell the truth, I want it for myself."

Folk in ordinary walks of life may not know that Richards is one of the foremost builders of ship models in the United States, but it is known in private and governmental shipping circles. Besides his work for the big shipping companies, most of it tedious hand-work made accurately to scale, he has designed boats for a number of foreign governments, and during the war he was called to Washington as an expert model-maker by the Bureau of Construction and Repair of the Navy Department. He also made all of the half and interlocking models used by the Submarine Defense Association. He is a member of the New York Model Yacht Club, which holds regattas on the lake in Central Park every Sunday morning in the summer.

How Big Can They Build Them?

The problem of the large airplane and how it was overcome

By Carl Dienstbach

HOW large can airplanes be built? Mathematicians once maintained that it was impossible to carry the size of an airplane beyond certain definite dimensions—dimensions dictated by theory. The men of figures argued that airplanes had already reached their limit of size and carrying capacity. Why? Simply because the weights increase as the cubes of the similar dimensions, while the areas of the supporting surfaces increase only as the square. In other words, the ratio of weight to area increases as the linear dimensions until the point is reached where the machine will not fly

So dictates theory; but what has practice to say? Practice answers these mathematicians just as it answered those who were kind enough to inform Langley that flying was impossible so that he would be saved a lot of unnecessary work! Langley kicked the theory of the mathematicians to death. The "law of the cube" has also been outlawed.

The Mathematicians Were Wrong

During the war the desperate necessity of making larger airplanes developed. Aeronautical engineers were instructed to design larger machines, regardless of the restrictions that were theoretically visible. Aeronautical engineering took a great step forward, and today giant machines wet their wings in the misty clouds. Theory was battered down, brushed aside, and forgotten. Today no practical limit is placed on the size of airplanes.

How came the mathematicians to be in error? They forgot something. They forgot that the most sacred law of the cube held good only when a large airplane was a geometrical copy of a small one. When an airplane is so designed that it is not a copy of a small one, there appears to be no limit to the size it may reach. When this was proved the law of the cube vanished in the wake of many other scientific superstitions.

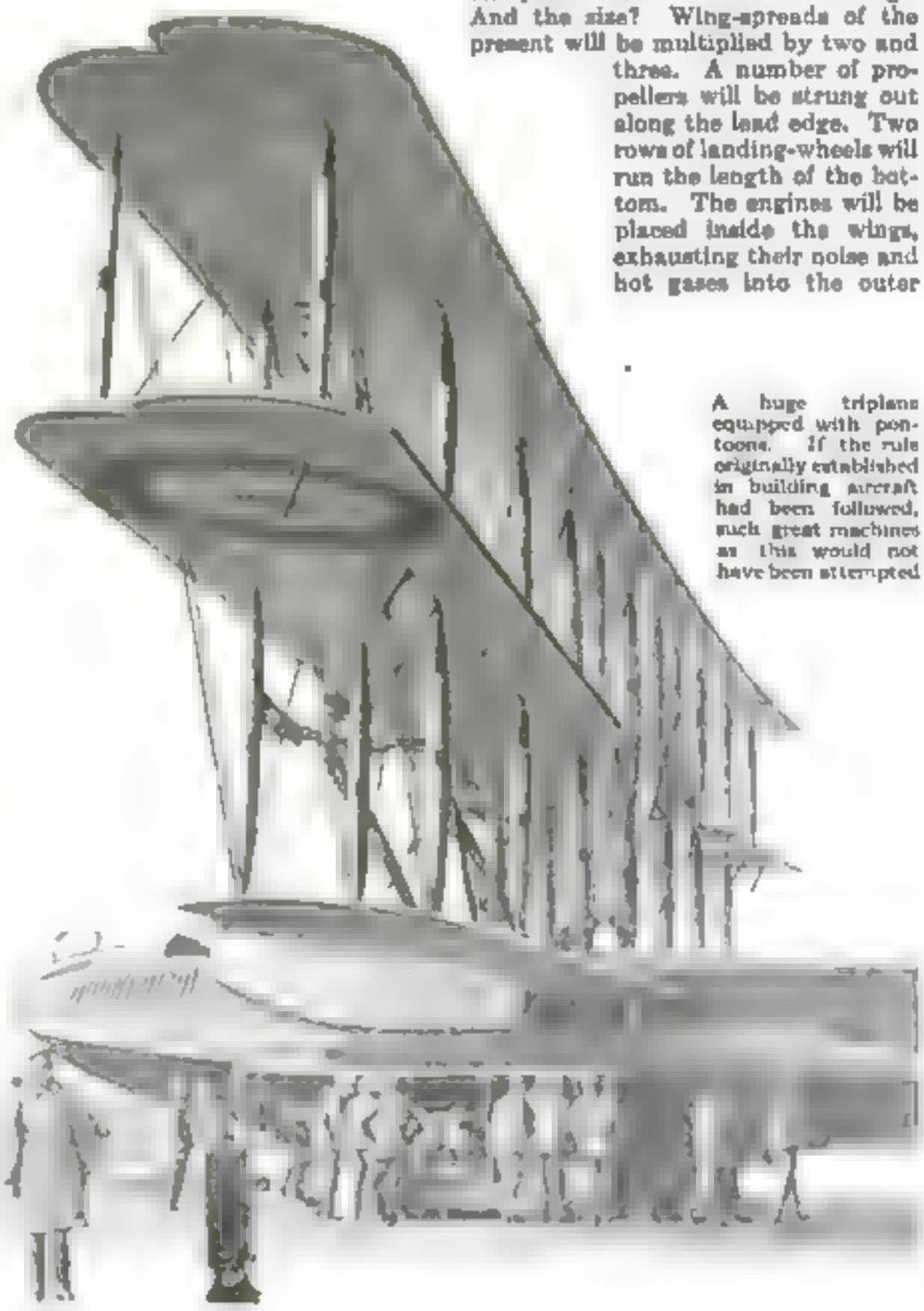
New aerodynamical laws have been laid down that tell how large airplanes may be built. Practice, not theory, molded these new laws into shape. They are very interesting, even to the layman. The first law states that with an increase in overall dimensions the weight must not increase faster than as the square of such dimensions. So far, so good. The second law is also a cold statement of fact. The substance of it can be made known with these words: The larger elements of an airplane must be so designed as to secure, for a given wing area, the minimum of secondary structure.

There is certainly nothing confusing about these deductions.

Flying is Easy; But Landing!

At present, difficulties of operation make themselves felt long before the limit of size is reached. A *flying*-machine can be made any size; but every flying-machine must also be a *landing* machine. This is where the shoe pinches. The landing problem is one thing that is helping to keep aeronautical engineering lashed to its present standards. Unfortunately, the larger an airplane, the more difficult it becomes to land. Large airplanes also make necessary large landing-fields.

Aeronautical engineers today dream of great achievements in the future. They are encouraged by the fact that all the difficulties confronting them are practical in nature. No law, written or unwritten, puts a limit on the size of airplanes. Every engineer with imagination can see in his mind's eye the great mechanical birds of the future. It is quite possible that the passengers and pilots will be carried in the wings. And the size? Wing-spreads of the present will be multiplied by two and three. A number of propellers will be strung out along the lead edge. Two rows of landing-wheels will run the length of the bottom. The engines will be placed inside the wings, exhausting their noise and hot gases into the outer



A huge triplane equipped with pontoons. If the rule originally established in building aircraft had been followed, such great machines as this would not have been attempted

atmosphere. This simple description by no means taxes the imagination, nor does it stand outside the realm of the possible.

Everything is in favor of the large airplane. At first it was thought that the increased head resistance due to more elaborate "rigging" would be a serious obstacle to overcome. It was not nearly so serious as was anticipated, for this reason: The size of the open "draggy" cockpits in the large machines became a relatively insignificant factor. The streamlining—the forms offering the least resistance to the air—of the larger machine is more perfect, and this more than compensates for the head resistance. With the large day bombers and Gothas came the enclosed cabin, with its luxurious fittings and perfect comfort. Of course, the huge airplanes used for bombing in the war were not provided with cabins, merely because the cabin did not meet fighting conditions.

Without enclosed cabins commercial aviation would always have been a dream.

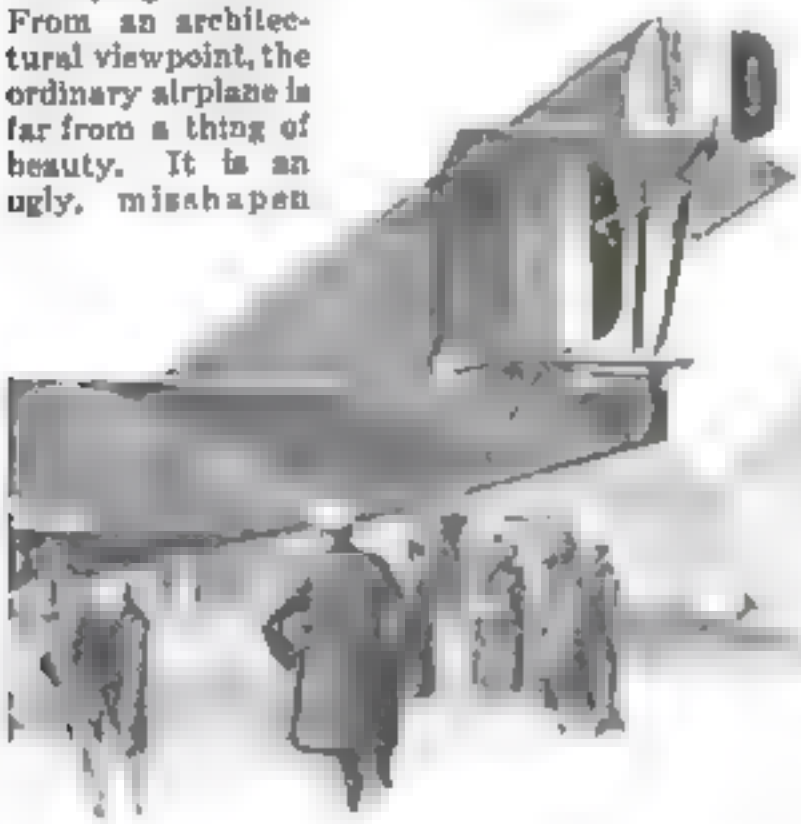
Flying in Comfort

With it arrived a new era in flying. Today a man can step off the street in his Palm Beach suit, sit down in the comfortable seat of an airplane cabin, and go soaring aloft, feeling neither the intense cold of the upper regions nor the terrific blasts of the passing air. The annoying roar of the engine is also reduced; all the comforts of the limousine are possible.

The enclosed cabin greatly beautifies the flying-machine. From an architectural viewpoint, the ordinary airplane is far from a thing of beauty. It is an ugly, misshapen thing. Its appearance makes the layman chary of trusting his life in it, but the cabin gives a sense of security.

The cabin adds a touch of symmetry. The first automobiles were not pleasant to look upon. The modern limousine is a thing of beauty. It bears a touch of art. The airplane has not yet passed a great distance along its path of evolution.

Large airplanes with several engines afford greater safety than those with only one. When one engine fails, the others can usually be depended upon



As airplanes grow larger they become less difficult to handle in the air. This may be contrary to what most laymen believe, but it is nevertheless true. On the other hand, the larger machines are very difficult to land, and they also require large landing-fields. When in the air they almost fly themselves. The duty of the pilot has been reduced largely to a matter of finding the way and landing safely. Navigation in the air is just as important as navigation on the sea. The "air-captain" is coming into his own. He must be a thoroughly trained man.

One man will by no means make up the "crew" of the large commercial airplanes of the future. There will be at least two pilots and one engineer. It is possible that machines will also carry a captain or navigator. It will be the duty of the engineer to see that the engines give unfailing service, and to make rapid repairs in the event of one of them becoming disabled.

The mention of engines brings up the question of safety. The passengers of the single-motored machine are entirely at the mercy of that one engine. It must not fail.

Large airplanes must be driven by several engines, and if one fails it will result in nothing more serious than a reduction of speed. Thus, the safety factor of the big airplane is greatly in favor of its use.

Does the radius of action increase with the size of an airplane? This is a question that the layman is sure to ask. Many believe that it does. The truth is that it does not to any great extent. In this respect there will not be much advantage in large fliers. Engineers have, so far, been satisfied to learn that the large machines reach about the same standard of general efficiency as the smaller ones. In the case of the dirigibles, the radius of action does increase with size because the efficiency increases. If the cargo of the large airplane is reduced in favor of a greater fuel supply, the radius of action will be increased.

The history of the automobile tells us what to expect in the development of aviation. The little *chug-chug* automobiles of fifteen years ago could not possibly struggle over the poor roads of that period. Were new roads built to accommodate the cars? Not at all. Manufacturers had to develop their cars to the point where they were able to travel over the bad roads. Then the good roads were built. Will the same hold true in aviation? Will manufacturers have to construct machines that will land with safety in any field or will a great belt of landing-fields be placed at intervals all over the country? It is safe to prophesy that the development of the airplane will always keep ahead of the development of the good landing-places.

Stunting Ability Not Necessary

It is obvious that the larger airplanes cannot "stunt," like the smaller ones. Stunting, however, is not necessarily an attribute for a commercial machine. The military necessity for an airplane capable of maneuvering rapidly will always be met by the smaller types.

The larger machines must always fly on an "even keel," so to speak. Such stunts as tail-spinning and nose-diving would set up dangerous strains in a large machine and a disaster would probably be the result.

How Your Sardines Were Scaled

THE scales have already been removed [illegible] when you ope[illegible] scaling done by hand? [illegible] more. Observe the [illegible] shown above.

The sardines are place[illegible] cylinders, which revolve from right to left. The continued rubbing of the small fish against the perforated cylinder case causes the scales to break off. A constant stream of water played on the fish carries off the scales as soon as they are detached.

When the fish are thoroughly scaled they are dropped into a [illegible] purpose at the [illegible]

Glass that Bullets Cannot Puncture

"GLASS that is bullet-proof? Impossible!" But [illegible] not.

This glass recently invented was put to a test in which steel jacketed bullets of regulation caliber were discharged at it from rifles and revolvers.

The bullets damaged the glass, but they did not pass through it. Instead they were dashed into fragments.

In the manufacture of the glass, sheets of plate-glass are thoroughly cleaned and cemented together with sheets of celluloid between.

These sheets are bound into a unit, producing a panel that retains the transparency of the best [illegible]

A Hospital on Wheels

PORTLAND, Indiana, is trying out the portable hospital idea for districts not sufficiently settled to make worth while a regular isolation hospital for contagious diseases.

The at-your-door hospital is large enough to accommodate a standard size hospital bed, a table, a small heating-stove, and one rocking-chair. Besides the door, five windows are provided, the rear one being placed in such a position above the bed that drafts do not strike the patient.

The Brass-Tube Queen

WHEN the chief of the Masai tribe takes unto himself a wife, he places around her neck yards and yards of brass tubing, which she must never remove. She also wears earrings made of steel coils that weigh more than a pound each. Any woman who can carry all that metal around with her deserves to be a queen.

As a matter of fact, she is the only woman in the tribe who has any independence; the others are bought and sold for a few cows or spearheads.

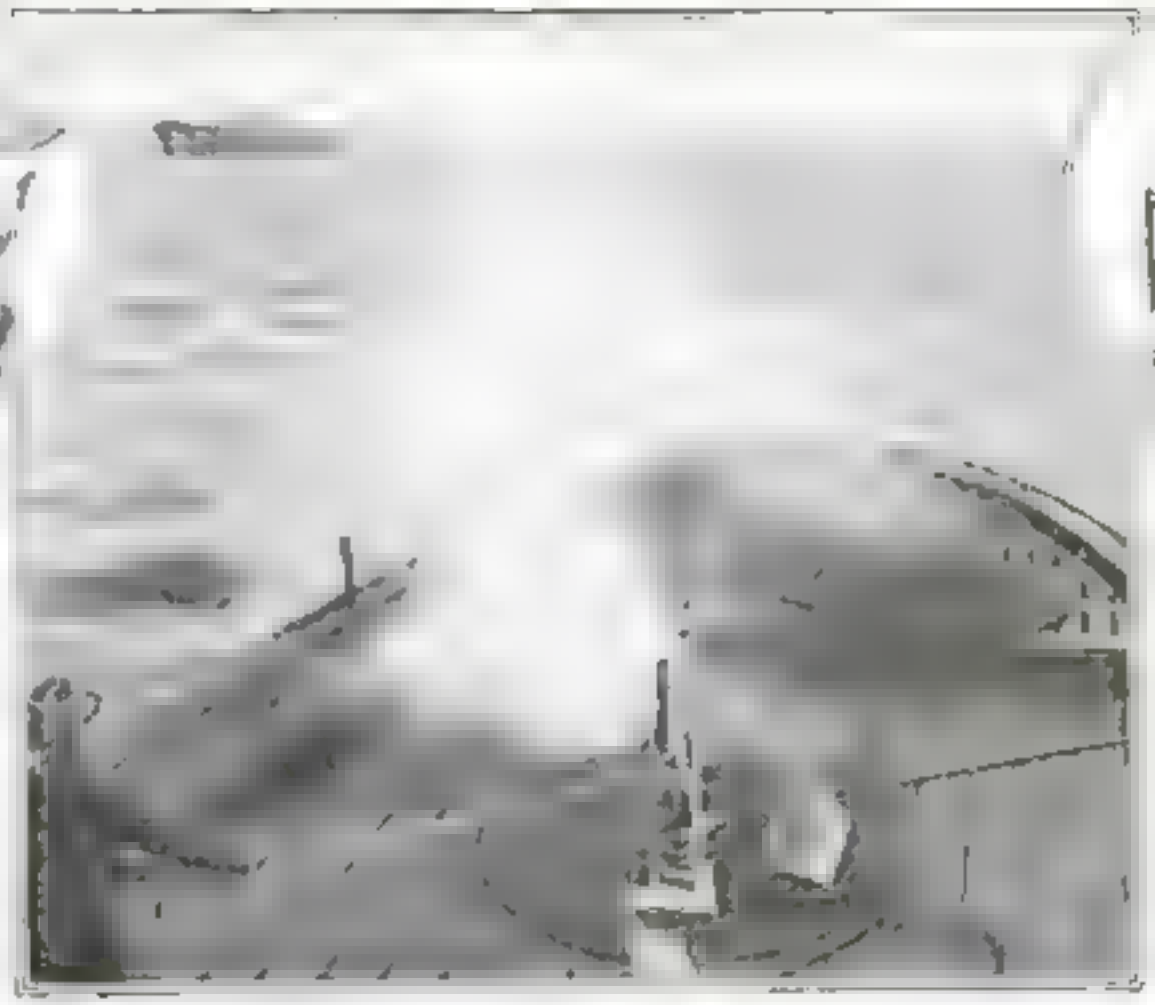
Dispossessing an Ark

BELOW appears a ship that was in Popular Science Monthly once before. That was in August, 1919, when Parson Lewis had just started to build it. He intended to sail in it to Liberia, the land of his birth, and to do missionary work.

So far, he has built the hull of old lumber and has poured into it a layer of concrete.

Recently the owner of the land on which Mr. Lewis is building his ship, which might very appropriately be christened *Faith*, ordered him to move. He did not do so, and the sheriff appeared on the scene.

But how can the sheriff remove the ship without injuring it?



Clean Your Pipe on the Ash-Tray

THE smoker who must get up and stir around to find something with which to clean the bowl of his pipe is needlessly inconvenienced. If he possesses one of the new ash-trays having a pipe-cleaning attachment, the sophisticated allure of smoking may be enjoyed without any inconvenience.

Without leaving his easy chair or even getting into an uncomfortable position, the smoker provided with the ash-tray shown above can thoroughly clean out the bowl of his pipe.

The pipe is inverted, placed over the prong rising from the center of the tray, and moved about slightly; the ash and residue immediately loosen and drop into the tray. The prong is also convenient for extinguishing cigarettes, since the burning end can be cut off simply by pressing it against the prong.

A Cannon that Saves Instead of Destroying

WHEN this cannon fires its shell in the eternal fight against the waves of the storm-tossed sea, it is to save lives, not to destroy them.

It is a new life-saving cannon, having a range of more than seventeen hundred feet, which is calculated to throw a line to a ship in distress.

In a test made in New York harbor, the eighteen-pound projectile, attached to a line coiled in a tube beside the gun, was fired from the deck of the *John F. Hylan*, a police tug.

The cannon is thirty inches long and has a weight of two hundred and ninety pounds. It does not recoil, is quickly loaded and can be easily moved. On the first trial the cannon threw the line seventeen hundred feet.

When You Forget Your Ink-Dropper

HOW can the fountain-pen be filled without having a dropper handy? A man does not usually carry a dropper with him. But in the crowd at hand there is likely to be some one who has a self-filling fountain-pen. If he can be induced to lend it for a moment the trick is done.

Take the self-filling pen and steep it in ink until it is full. Assure the owner that no damage will be done to the point of his valuable self-filler, and permit him to watch the following performance.

Press the lever of the borrowed pen, and through its point discharge its contents of ink into the barrel of your own pen. Then refill the borrowed pen and return it.

There are many such instances as the above in our daily lives, requiring but a little ingenuity of thought to simplify a condition that otherwise would have to be tolerated in spite of inconvenience.

Shelf and Work-Bench in One

A WORK-BENCH that will fold up and fit in a tool-chest; that when opened will form a shelf for the tools, and at the same time afford a bench for working, is surely a serviceable aid to the carpenter. But that is not all this work-bench will do. It can be used as a truss or "wood horse" to support a platform on which the workman may stand!

To fold the bench it is necessary only to remove the plank that forms the top, and to turn the side plates vertically to permit the lower section of the legs to be folded back inside the upper bars of the bench legs. The leaves of the shelf are folded over, and then the leg members are folded on top of the leaves. This makes such an arrangement so compact that the device may be readily placed in the tool-chest.

This device is a valuable adjunct to the carpenter's kit.

Potato-Gathering Made Easy

IT will no longer be necessary for the potato-picker with row upon row of potatoes to gather to stoop over or kneel on the damp ground for hours at a time to bring forth the "spuds." Instead, he will have but to pass along each row, poking a grabber-like device at the potatoes which have been dug up. No potato can resist the clutches of these curious "tongs."

The potato-picking device was invented by Albert Hosefeld, of Lewiston, Minnesota.

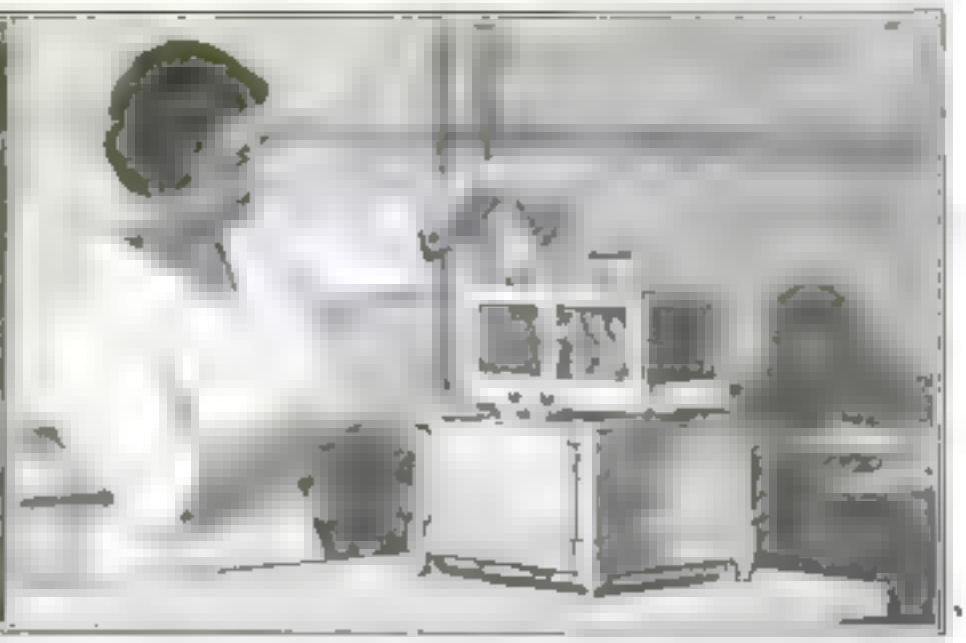
The legs of the tongs are connected at one of their ends by a flat V-shaped spring rigidly secured by rivets. A flexible rubber strap connects the prongs of each pair on the inside, while a coil-spring holds the strap taut.

These tongs save the gatherer many an hour of back-breaking toil, especially if they are supplemented with the long-handled basket carried by the young man shown in the picture.

A Stereoscope Built for Two

HERE'S a stereoscope designed to accommodate two people at the same time. In the top of the upper compartment is a brilliant light-source diffused by a screen of opal or ground glass. A partition through the lower compartment has an opening in which the glass positive, a stereoscopically photographed slide, is placed to be viewed from opposite sides. Between the slide and the eye lens is an unsilvered sheet of plate-glass, which acts as a mirror by reflecting the diffused light of the upper ground glass, making it serve as a white background.

Black velvet beneath the mirrors prevents reflection of light from below.



Let the Oven Mind the Toast

YOU don't have to watch your toast when you put it in the new electric toasting oven shown above. The oven will automatically take care of it for you. All you need to do is to place the slices of bread in receivers, press two levers downward, and turn on the juice. By pressing the levers you lower the bread into the oven proper.

There is a timing device at the front of the oven that can be set to suit your individual taste. Thus, when the bread is toasted to the proper brown, the current is automatically turned off and the toast is raised out of the oven. Many electrical appliances seem actually to think.

Wireless on the Boardwalk

MUSIC with your meals is an old story but music received wirelessly while you are rolling along the boardwalk is something else again. These people are listening to a phonograph record being played several miles away.

This special type of wireless receiving outfit is the invention of Harold Warren, of Asbury, New Jersey. It is small, compact, and relatively inexpensive. It reproduces music audible enough to be heard above the noises of the boardwalk.

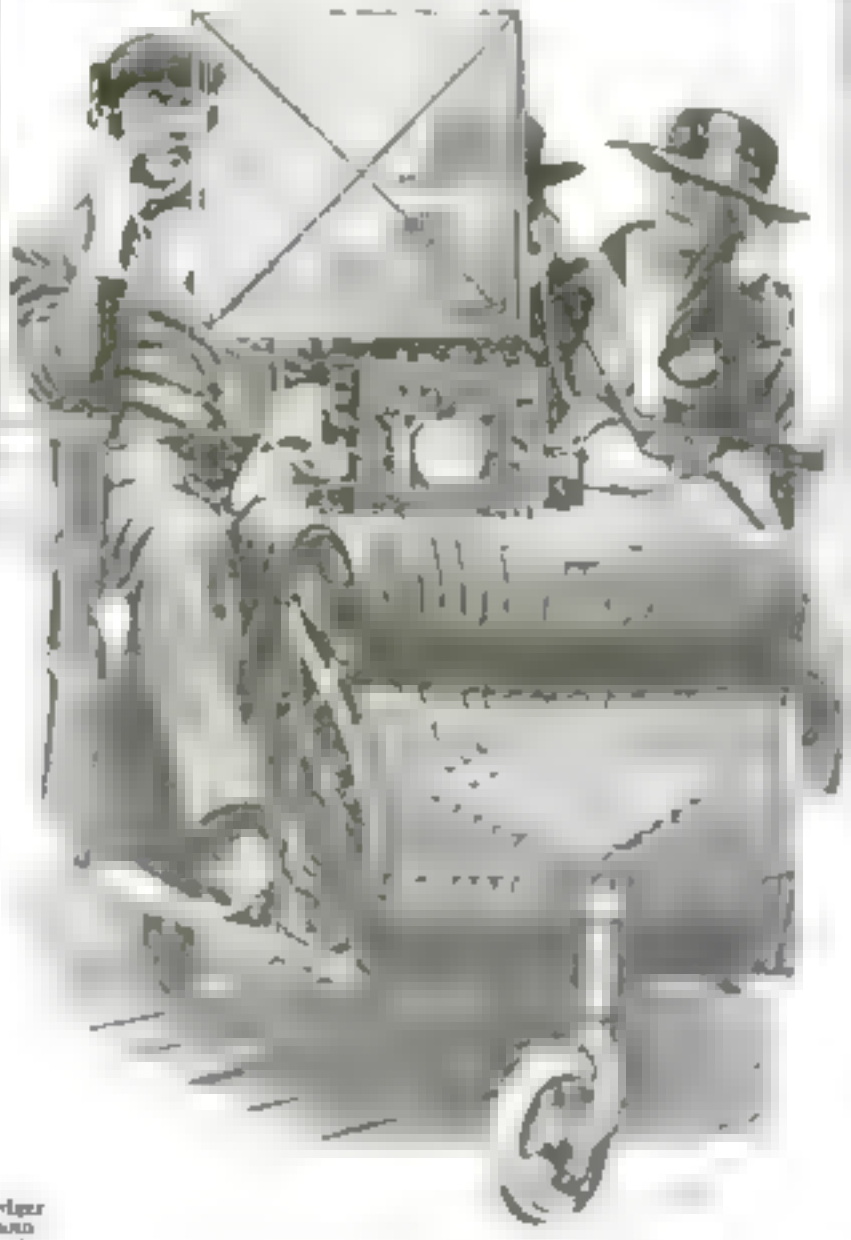
An ultra-sensitive receptor with a small loop antenna makes it possible to enjoy opera or jazz with the sea breezes. What next?

Do You Take Your Dog to the Dentist?

IF you love your dog, have his teeth examined regularly. A dog's teeth are just as apt to decay as human teeth. But he must suffer in silence, without even the comfort of holding his paw against his aching jaw.

Dentists find that dogs are very apt to shut their mouths unexpectedly and smash all the instruments within. A rigid clamp that can be strapped to the dog's head like the one shown herewith will do away with this difficulty.

This clamp also assures your dog humane treatment.



© Leiger Photo Service

This Rudder Makes the Boat Behave

THIS rudder gives perfect control over a boat. Two semicircular pieces are mounted on two shafts, one within the other. The pieces can be turned independently or together.

The normal position of the rudder parts is shown.

The boat's direction will depend upon which half of the rudder is moved. If both the pieces are brought together at the same time, forming a cup at the back of the propeller, the boat will stop and then move in the opposite direction.

A Street-Sprinkler of Siam

IN Siam they don't have water-wagons of any kind at all. When the streets grow hot, a member of the street-cleaning department hangs a pair of watering-cans on the ends of a wooden bar and places the bar across his shoulders. A handle on each can enables him to direct the flow of water.

The water-carrier himself is always cool. He walks through the water he has just sprinkled, and can sprinkle himself occasionally if he should grow too warm at his task.

A Safety Catch for Your Tie-Pin

THERE'S hardly a man or woman who has not lost a tie-pin or brooch at some time. And many of the lost pins were valuable

Why not put a safety catch on them?

Mr. Harvey Bailey, of New Jersey, has invented a simple catch. It is shown above.

The pin, instead of being straight, ends in a loop that fits snugly over a ball-shaped projection. Even if the hook should be pulled off the knob, its very shape would keep it from sliding out of the cloth

The whole pin would hang at the end of the hook until rescued

This Pilgrim Risks His Life to Pray

PILGRIMS of the Taout order wishing to pray to "acquire merit" or "attain their heart's desire," visit one of the shrines on top of Hua-shan mountain. To do so they endanger their lives, for the ascent is very steep and the supports insecure.

The Chinese pilgrim below is shown standing on wabbly logs that are laid across posts driven into the face of the mountain. He balances himself by holding on to a chain. Below him is a sheer drop of fifteen hundred feet. If he reaches the shrine in safety his wishes are supposed to be granted Thousands of pilgrims climb this mountain every year.

He Wears a Show-Case

WHY rent a store in order to sell candy? Here is a man who wears his candy show-case in front of him. It hangs from his shoulders by means of straps. The case is thirty-two inches long, sixteen inches wide, and fifteen inches deep. It is made of transparent celluloid, but has a zinc bottom; the whole case weighs only six pounds. At the side there is a metal money-changer.

The salesman fills his show-case with taffy and walks through the theater district of Los Angeles at matinée-time. One day he sold forty-seven dollars' worth of taffy.

Here Is One Spot that Isn't Dry

MOIST tobacco is the only kind to smoke; that's why it is usually put in an airtight container

But there are other ways of keeping it moist.

Take, for example, the pouch shown herewith.

The flap is lined with material that absorbs water rapidly. When the flap is moistened and then closed down, the tobacco within will remain sufficiently damp.

In dry weather the flap needs to be moistened every other day.

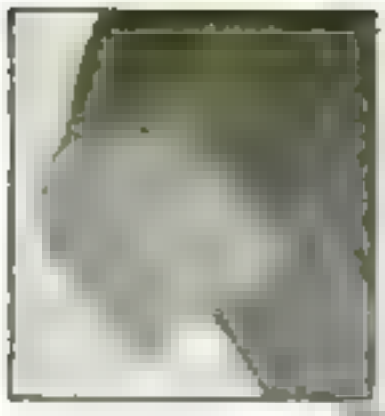
New Light for the Photographer

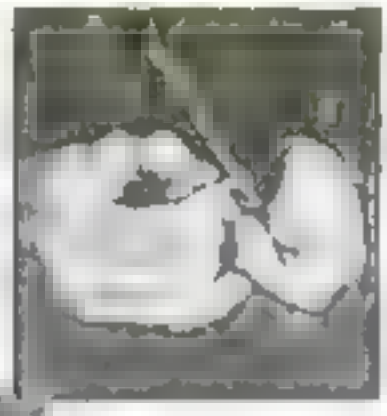
"GOING to make flash-lights?" they asked the photographer who had come to take a portrait in the dimly lighted room.

"No," answers the photographer. "I brought my electric light."

From his coat pocket he takes a powerful little bulb, which, when backed up by a reflector, is strong enough to make short exposures with a fast lens.

Its light is rated at 450 watts. Its use will banish that scared expression that flashlight subjects usually wear.





The Rubber Heel with a Noise

RUBBER heels are sold by the million, not because they are noiseless, but because they are springy. Even more people would wear them if they made a noise. Criminals almost to a man wear rubber heels.

Also the rubber heel is open to the criticism that it slips on wet pavements. Water is to rubber what oil is to iron—a lubricant. Hence the many futile attempts to form the rubber heel with so-called vacuum cups and similar indentations.

"You talk like a man—why walk like a thief?" asks Mr. John Van Heusen of Jamaica Plain, Massachusetts. He answers the question himself by inventing a rubber heel which makes a noise as it strikes the ground and which does not slip. In a word, he combines the resiliency of rubber with the sturdy noise of leather.

To attain his object Mr. Van Heusen sinks into the rubber heel, near its outer edge, a piece of steel, which, when it strikes the ground, relieves the wearer at once of the charge of "pussyfooting."

A Good Way to Secure Piling to Rock Bottom

IN the construction work at the Erie Basin end of the New York state barge canal at Buffalo, an interesting method of holding the bottom of a sheet-piling wall at rock elevation was used.

Instead of drilling a costly trench into the rock for anchoring the bottom of the piling, it was rested on top of the rock. Then three-inch steel bars seven feet long were placed in four-inch holes drilled four feet down into the rock directly in front of the piling.

The steel bars, bearing against the face of the piling for a distance of three feet, prevented it from being forced outward either by the pressure of the earth behind or by the load carried on the wharf.

A Pencil that Lights Your Cigar

GI[illegible] my pencil," answers the man with a cigar-lighter attached to the end of his pencil.

The top of this pencil pulls out and discloses a wick and metal point. When the metal point is scratched in a groove at the side of the pencil, a spark is produced that lights the wick. When the top of the pencil is replaced, the flame is extinguished.

Inside the pencil there is a hollow chamber lined with absorbent material into which the cigar-lighter fits. The absorbent material is kept moist with kerosene or some similar fuel. Thus the wick attached to the lighter is always saturated because of its close contact, and will flare up when a spark is created.

This little device will be a great friend to smokers. It will last a long time and will always be just where it is needed—held to the coat pocket by a clip, giving the smoker a twofold assurance of a light when he most needs one—which often happens when he is out on a tramp, miles away from houses and his fellow man.

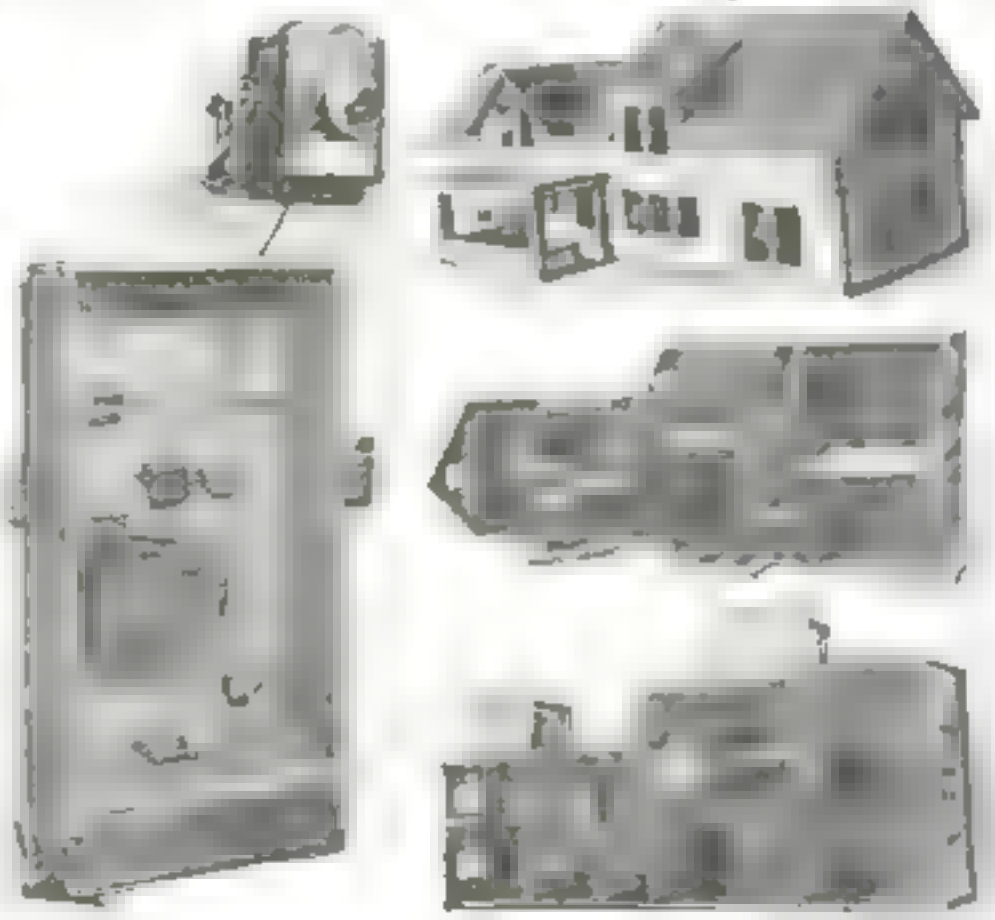
Here's a Phonographic Fire-Alarm

"FIRE! Call the fire department." But Central is slow to answer, so William J. Luce, of the New York Fire Department, invented this phonograph fire-alarm.

The explanation of this novel invention sounds like the old rhyme about "the fire burned the stick, the stick beat the pig, the pig jumped over the stile."

The house containing this phonograph fire-alarm is wired. The sensitive "heat" wires meet fuses, which form an electric connection with a magnetic coil in the alarm-box. Heat so affects this that an iron weight is released, which starts the phonograph record.

For fifteen minutes the record recites the location of the fire, the telephone receiver is lifted, and Central receives the message.



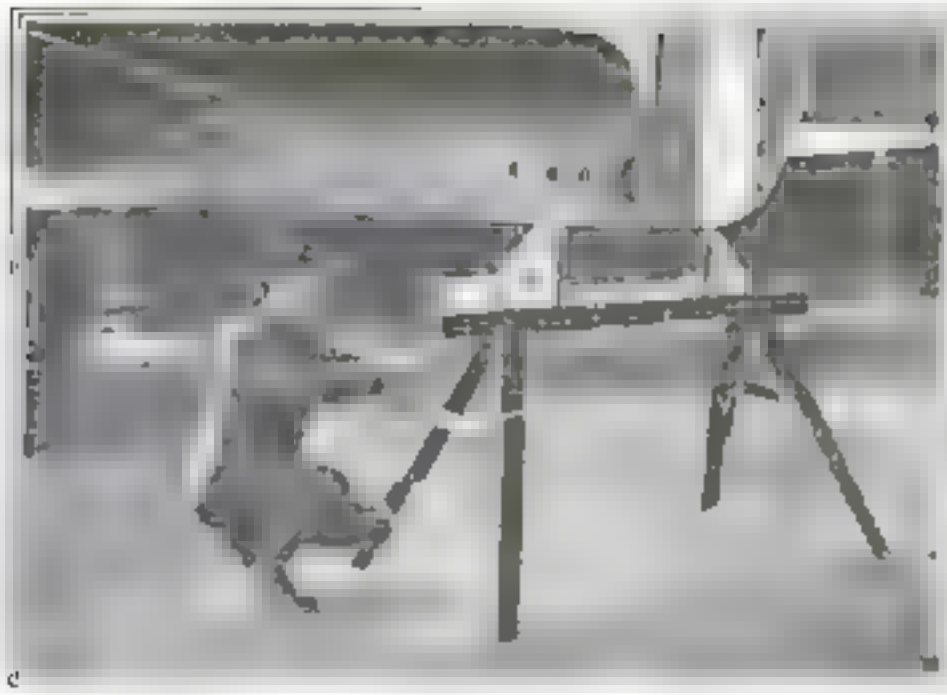
Why Not Make Your Own House Models?

"DON'T throw that corrugated cardboard away. Let us make the new house from it," suggested the prospective builder to the architect.

They did. The result was the tiny model shown in the illustration. This is how the experimenter explains the construction of the cardboard house:

"First we cut out the walls, straight up and down, and made openings for the doors and windows. We set up partitions between the rooms precisely as the architect had them in his plans. Each story was built separately, and the roof went on last. The sections were then pieced together.

"The result helped us to visualize our prospective house, and to correct faults and omissions."



A New Screw-Bench for Airplane Work

A SCREW BENCH having a vertical and horizontal adjustment for the support of airplane bodies has been developed by aviation mechanics at Rockwell Field, San Diego, California. By means of the new bench it is possible to place the body of the machine in the best position for the installation of delicate mechanical work.

In repairing, overhauling, and balancing airplanes, it is often necessary to have the body of the airplane in a very finely adjusted position. This is usually carried out with the aid of spirit-levels.

According to the old method of supporting the machine upon benches or blocks, the adjustment of position desired was often impossible.

With the screw-benches, however, the adjustment is altogether different. With the bench supporting the tail of the airplane, the position of the body may be moved horizontally or vertically the merest fraction of an inch. A micrometer is used for making the measurements.

Milking Cows by Electricity

THE cow will not kick over the milk-pail if she is milked electrically with the device shown above. Nor will she switch her tail in one's face. This automatic milker allows one man to milk as many cows as three men could by hand. It is also perfectly sanitary. The teat of the cow is squeezed by compressed air, and the milk is then sucked into the can through a rubber hose.

This little milker never gets tired, is always ready for work, and consumes very little current. The cows stand perfectly still while it is at work.

One man alone can milk fifteen cows in three-quarters of an hour with the aid of this new electric milker. And besides he is able to get more milk from the cows than he did when he milked by hand.

No pipe-lines, belts, gages, or tanks need be installed in order to use the milker.

Its value to the farmer of today, unable to find sufficient help, cannot be overrated. Of course most of the large wholesale dairymen are using some form of mechanical milker.

Overalls Are Not for Airplanes

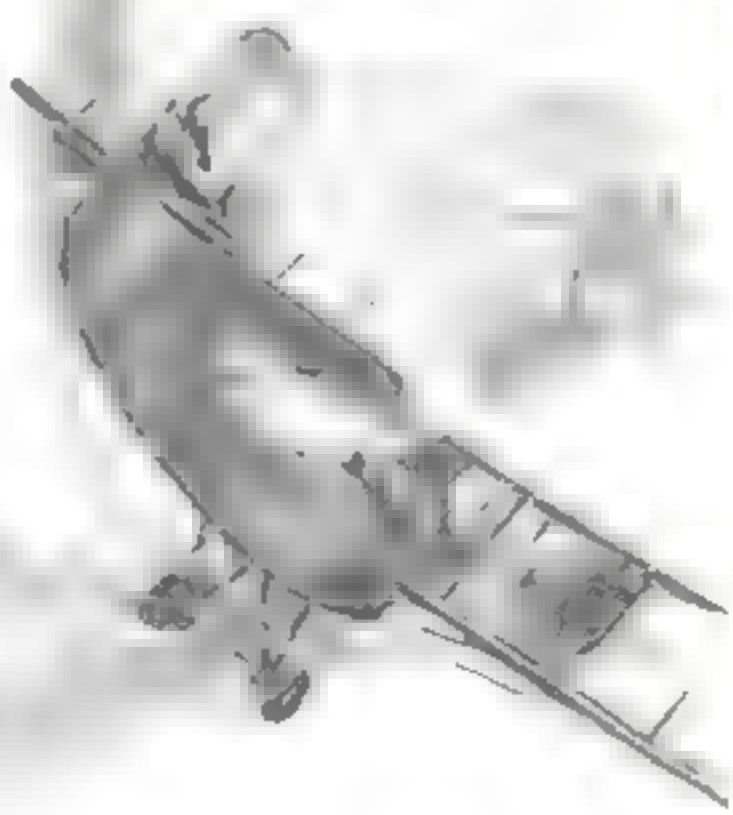
RUDDERS are meant to guide; not to wear overalls. The airplane rudder in the picture below caught a pair of overalls that blew out of the cockpit of its machine, became entangled in them, and sent the airplane into a dizzy spin. The pilot was unprepared for it, but he managed to right his airplane. Next minute the machine took another spin. After many strange twists and turns, the airplane finally landed abruptly on the flying-field.

When the pilot looked over the machine to find out what was wrong, he discovered his overalls, torn to shreds, wound up in the rudder. This happened at Atlantic City, New Jersey.

With Your Golf Pad On Your Wrist

WRIST-WATCHES are worn so generally that the new wrist golf-score pad will not annoy the golfer or interfere with his play. It furnishes him with a convenient place on which to keep his score.

A small pencil fits into a holder at the side of the pad. Each sheet is divided into two spaces, so that two players' scores can be recorded together. When one pad has been used up, the holder can be refilled. Players say that the pad does not interfere with a free wrist movement.



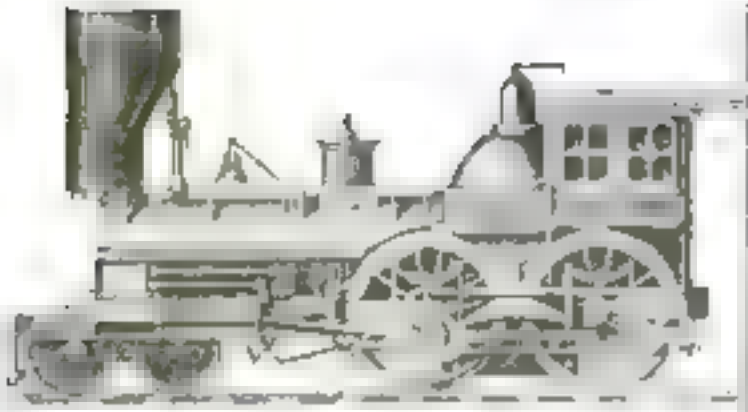
Brother to the Well Known Ouija-Board

PEOPLE are buying ouija-boards faster than the manufacturers can turn them out.

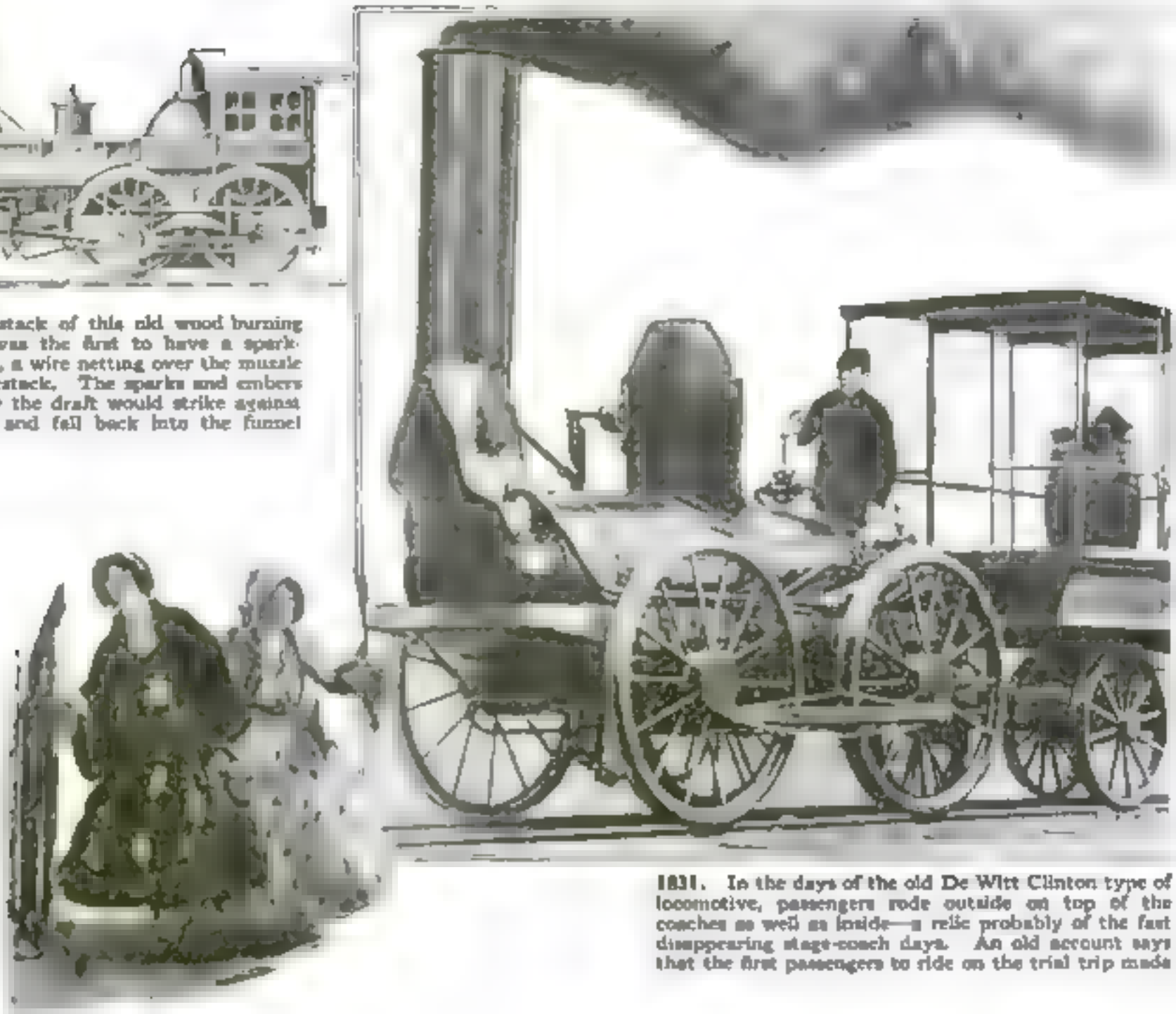
A Los Angeles manufacturer has decided that he may as well get rich on spirits while they are in vogue, and so he is manufacturing a new board, enough like the ouija-board to be its brother.

On this new board a single finger may be used to guide the three-legged indicator, and thus several people can work the board at once. Just how they know which message belongs to which person, we cannot tell. That is something that only the inquirers know.

The Smokestack Grows Steadily Smaller



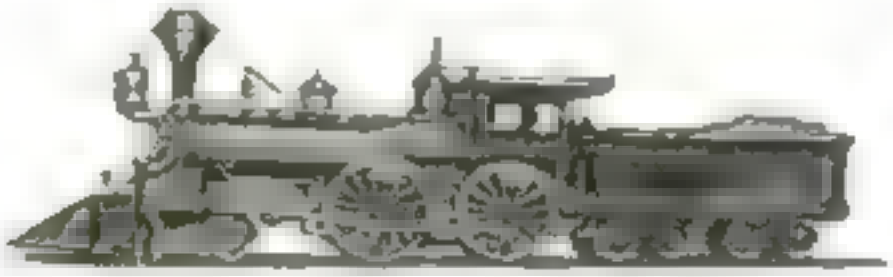
1840. The stack of this old wood burning locomotive was the first to have a spark-arrester, i. e., a wire netting over the muzzle of the smokestack. The sparks and embers forced up by the draft would strike against this netting and fall back into the funnel



1831. In the days of the old De Witt Clinton type of locomotive, passengers rode outside on top of the coaches as well as inside—a relic probably of the fast disappearing stage-coach days. An old account says that the first passengers to ride on the trial trip made

1860. The last word in wood burner smokestacks. Engines of this type figured largely in the operations of troops during the Civil War. Those were the days when locomotives had personality and were given names instead of numbers. Brass or copper bands around the smokestack or boiler or even different colors painted upon their sides, was the order of the day

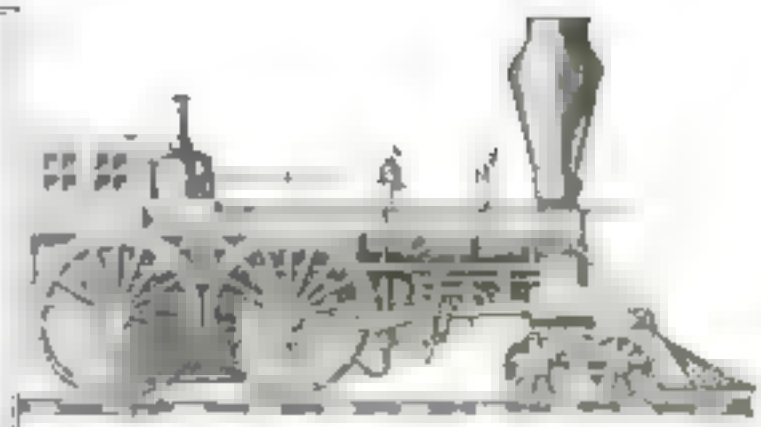
A relic of this desire for individuality still exists in the practice of some Southern railroads in this country, and one may occasionally see a mighty, modern locomotive, pulling a heavy express train, with the name of the engineer painted beneath the number on the cab, and with a brass or copper Masonic emblem, or star (according to the engineer's taste) upon the smokestack



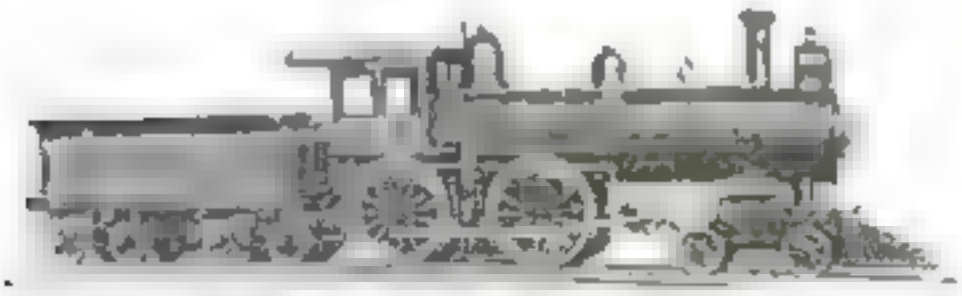
1874. The "bonnet" smokestack. An inverted cone placed on top of the stack. Sparks striking against this deflected into the bonnet, where the draft churned them until they were extinguished and pulverized sufficiently to pass through the netting

as the Size of the Engine Increases

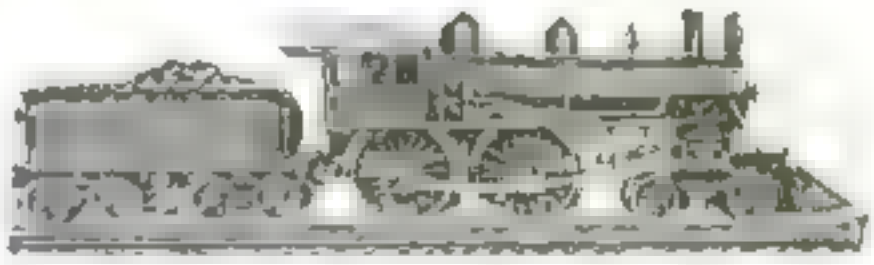
by the De Witt Clinton on the Mohawk & Hudson Railroad in 1831, received literally "a baptism of fire," from the falling sparks and bits of burning wood vomited forth from the tall stove pipe-like affair that served as a smokestack on the earliest American locomotives



1851. Here we have an improvement over the preceding smokestack for the reason that it was equipped with a larger receptacle for sparks after they had struck the netting. This receptacle was called the spark-chamber



1880. The first engine having the spark-arrester in the smokebox in front of the boiler. In this and later locomotives the smokebox was lengthened and extended beyond the point where the stack is placed, to accommodate the spark-arrester and spark-chamber in the smokebox



1893. The plain smokestack—simply a straight pipe—sometimes flared a trifle—through which the draft carries off the exhaust steam and smoke. The smokestack diminishes, though the boiler still carries its quota of protuberances

1920. Save in the matter of their relative size, there have been practically no changes in the locomotive smokestack since 1893. However, as the size of the boiler has increased, so, step by step, the proportions of the smokestack have gradually decreased, until on the mighty locomotive of our own day the stack is not eighteen inches high

The Mirage that Beckons Men to Death

Why do men see water and mountains when there are none?

DURING the fighting in Mesopotamia the British troops discovered one morning that they were shooting at phantoms. A news dispatch read: "The fighting had to be temporarily suspended, owing to a mirage; but upon this lifting our offensive continued." The same kind of witchcraft was befooling them that so often misled Napoleon's soldiers in Egypt, and that was first described in cold-blooded, scientific language by Monge, the French savant attached to Napoleon's expedition.

The reflecting surface of air is below the level of the observer's eye. He thus sees the image inverted

A party of American explorers not so long ago returned from a mirage-hunt in the Arctic. They went north to explore Crocker Land, which has figured on Arctic maps ever since Peary, in 1906, reported having seen from a mountain-peak in Grant Land "the faint white summits of a distant land" to the northwest. The recent expedition did not explore Crocker Land, because it wasn't there. What Peary saw was a mirage.

Three quarters of a century ago the American explorer Wilkes sailed along the Antarctic coast that now bears his name, and charted appearances of land at several points. A long-drawn-out tempest in a teapot has raged over these discoveries. Certain British geographers refused to believe that Wilkes saw land at all, and when the recent Mawson expedition sailed right over one of the spots where land is shown on Wilkes' chart, the case seemed to be proved. The same expedition, however, found that there is land, a whole continent of it, some scores of miles south of the latitude recorded by Wilkes. Probably he actually saw this continent at several points, but underestimated its distance on account of mirage.

The Mirages of Hot Cities

It is not necessary to travel either to the polar regions or to torrid deserts to see specimens of this interesting phenomenon. Some very fair examples of mirage may be observed, on still, hot days, over the asphalt of city pavements in our own latitudes—ranging all the way from a mere tremulous appearance of distant objects, to the apparent pool of rippling water that has deluded so many travelers in the desert. A recent writer in the London *Times* says:

I witnessed this afternoon a remarkable example of the mirage on the north side of Gruvenor Square. The whole surface of the roadway appeared a sheet of water. My first impression, before I realized what the phenomenon was, was that a water-main had burst and flooded the road. On approaching closer, the water broke up into pools, and then disappeared altogether. The disturbance of the heated layer of air by the motor-cars exactly reproduced the effect of wheels splashing through shallow water. I have frequently seen mirage in the desert of the Sudan, but I have never observed a more realistic exhibition.

Marine mirages are familiar to most dwellers by the shores of oceans and lakes. Describing mirages over lower New York bay, a resident of Sea Gate writes:

It is a very common occurrence to see the east shore of Sandy Hook and the coastline beyond (the Seabright shore) raised above the horizon, and occasionally this mirage will carry the sky clear under the Navesink Highlands. On a still, hot afternoon some large houses, towers, and chimneys on the shore of Staten Island will be raised in the air by a mirage, which occasionally is very beautiful and very suggestive of the descriptions of the desert mirages.

Passing vessels are often curiously distorted and enlarged, and this observer has sometimes seen vessels reflected in two perfect images, the lower reversed and the upper right side up. On one occasion he saw the funnels of a passing American liner apparently hundreds of feet tall, while the masts were lengthened out to wavy rods of incredible size.

Most Common at Extremes

Mirage is most common in hot deserts and in the polar regions, because such places most frequently furnish the abrupt contrasts in atmospheric density upon which the phenomenon depends. When air is warmed, it expands; when it is cooled, it contracts. In calm weather the hot level surface of a desert rarefies the air just above it. Most school books will tell you that the layer of thin air reflects objects above exactly as they are reflected by a sheet of water—the process known to physicists as "total reflection." Although this is not strictly true as a scientific statement, the net result is the same. The layer of rarefied air does act as a mirror, and an observer looking down upon it from a higher level sees a reflection of

In this picture the reflecting surface of air is above the eye level. Looking through the denser layer, the observer sees the mountain projected in the sky and apparently closer

The "Looming" Mirage that Deceives Explorers

The kind of mirage known as "looming" is one of the most interesting. There is no inverted image, but low shores may be reflected in the sky as high cliffs, and mountains and objects far below the horizon may appear in the sky and magnified.

Scott and his party made use of this phenomenon in the Antarctic regions for detecting objects beyond the normal reach of vision. The picture shows a landscape with palm trees and mountains as seen when lifted up and magnified by looming.

This is the kind of mirage that may have given rise to Peary's "Crocker Land"

Grotesque as well as beautiful effects are often presented in a mirage. Distant cities may be seen reflected in the air. Above is depicted the famous Fata Morgana

the sky, which produces the effect of an expanse of water. The unsteadiness of the heated air gives an appearance of ripples, and the effect is made still more realistic if trees or other terrestrial objects are reflected along with the sky. The common mirage of the desert is known as *inferior mirage*.

Distant Objects Heightened

The form of mirage most common in the polar regions is known as *looming*. This has the effect of increasing the apparent height of distant objects; and it may lift into view objects that, in a normal state of the atmosphere, are hidden by the curvature of the earth or by intervening hills. Wilkes probably saw the "loom" of the Antarctic continent, while Peary was misled by the looming of ice-fields and icebergs. This lifting of remote objects also produces, by a natural association of ideas, an illusory effect of nearness.

Another phenomenon frequently met with in high latitudes is *superior mirage*. In this form of mirage inverted images of ships, icebergs, or other objects are seen apparently suspended in the sky.

Both looming and superior mirage are due to conditions exactly the reverse of those that produce the inferior mirage of the desert. A cold sheet of water or ice is overlain by a layer of abnormally dense air. Looming is the result of the refraction (bending) of rays coming from objects above the dense layer; superior mirage, to the reflection of objects within it. Both processes may be roughly reproduced by the following experiment, in which water, which is a transparent medium much denser than air, represents the dense lower air that produces mirage.

Fill a glass about half full of water. Hold it somewhat above the level of your eye and close to a wall covered with figured wall-paper (any vertical surface with distinct marks, letters, or the like, will do as well). In a certain position, the surface of the water, seen diagonally from *below*, serves as a mirror, reflecting the wall-paper with its pattern reversed. With your eye considerably lower, you will be able to glimpse the pattern *through* the water surface, erect but apparently lifted much above its true position. The former case is analogous to superior mirage; the latter, to looming.

Sometimes air layers of different density are side by side, and then we get *lateral mirage*. This may often be seen by looking close along the side of a brick or stone wall on a hot day. More than two horizontal layers may produce multiple images. Lastly, a mixture of several masses of air of different densities results in combinations of the different kinds of mirage, and we see objects variously distorted. Some remarkable cases of this kind are shown in the classic drawings of William Scoresby, the Arctic explorer. He tells us that along the shores of Greenland "the general telescopic appearance of the coast was that of an extensive ancient city, abounding with the ruins of castles, obelisks, churches, and monuments, with other large and conspicuous buildings—a grand and interesting phantasmagoria."

Origin of the Fata Morgana

The *Fata Morgana*—a weirdly distorted view of the Sicilian shore as seen from Reggio—is also due to a combination of different forms of mirage.

If there seemed to be a chain of mountain peaks looming quite near with their lofty summits clearly outlined against the sky, the observer rising in a balloon or an airplane would soon see them vanish, dwindling into the nothingness of a haze. Far in the distance he might detect with the aid of powerful glasses, a chain of real icebergs, or remote mountains. The part of their summits which protruded above the denser layer of air would be seen reflected inverted as in a mirror on the ground. They would then appear as distant mountains reflected in a body of water.

What seem to be deep pools of rippling water in the sandy valleys between desert mountains. Caravans wading through these reflections find no substance in them

Compressed Air Takes the Place of Muscle

THE man who moves a tool back and forth across a surface of steel or wood, giving to the surface a suitable finishing touch, can now perform this work three times as fast by employing compressed air, which is controlled to furnish the moving power of the tool, and at the end of a day's work his muscles will not ache as they ached when he did the work entirely with his own energy.

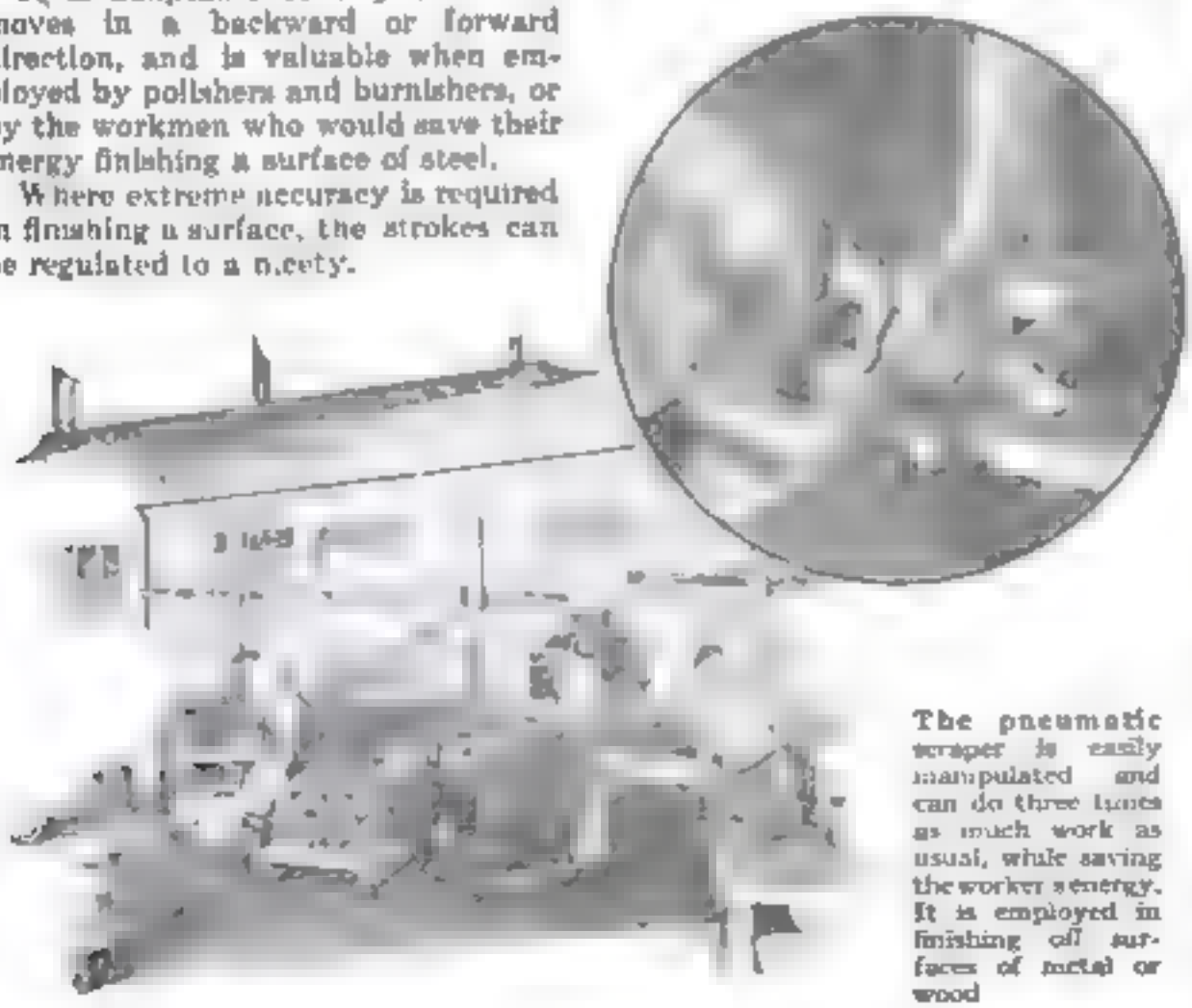
An advantage of the mechanical "scraper" is its adaptability to strokes of various length. With the right hand the operator grasps the valve that controls the power, and by automatic management he is able to impart either a long stroke or quick, short strokes. The movement can be halted in an instant. A slight movement of the workman's right hand produces the forward stroke; slightly releasing his hold on the valve causes the tool to return, ready for the next stroke.

Scarcely less important is the support of the tool. Either a stationary or a movable support can be used, the latter having casters or small rollers which make it easy to move. A bracket carries the beam which enables the apparatus to be clamped around the upright support, or to be raised and lowered. Four rollers carry the scraper along the under side of the beam, while a "universal" joint permits it to be turned in any direction.

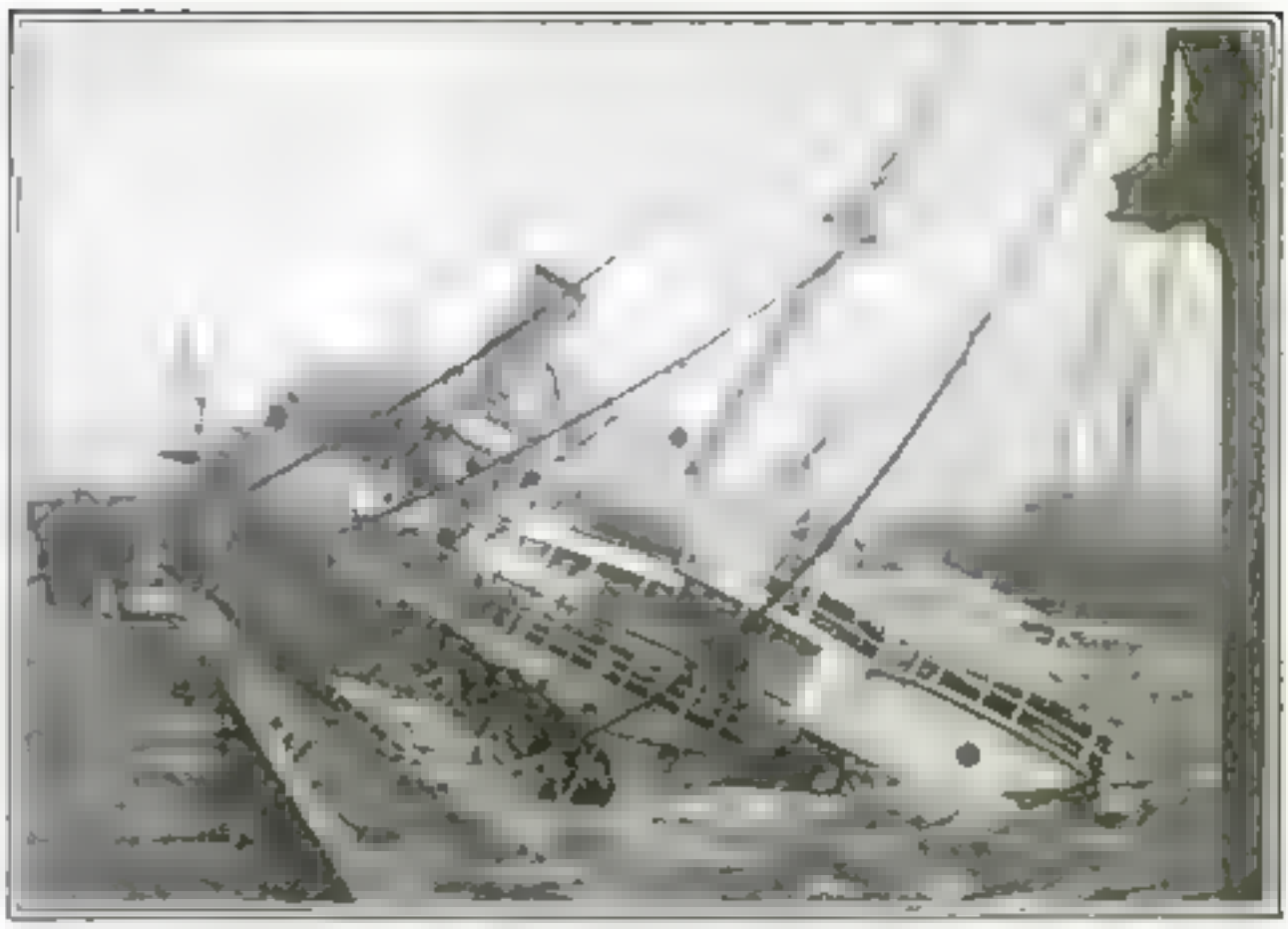
Mr. Swan F. Anderson, of Rockford, Illinois, is the inventor of this labor-saving device.

It is adaptable to any tool that moves in a backward or forward direction, and is valuable when employed by polishers and burnishers, or by the workmen who would save their energy finishing a surface of steel.

Where extreme accuracy is required in finishing a surface, the strokes can be regulated to a nicety.



The pneumatic scraper is easily manipulated and can do three times as much work as usual, while saving the worker's energy. It is employed in finishing off surfaces of metal or wood



When the *Moccasin*, which sank at her New York wharf, was raised, she had a pronounced list. This was corrected in an unusual manner

Seeking Gravity's Aid to Right a Ship

GENERALLY speaking, ships that sink in the depths of the sea are "down and out" forever. But ships that go to the bottom in depths of two hundred feet are now being successfully raised, and many ambitious schemes are being promoted for raising ships from depths that are even greater.

The *Moccasin* sank alongside her wharf in New York. The sinking was from "unknown causes"—perhaps it was from the opening of an ashes port or sea valve. In salving her, all compartments, hatches, and deck openings were first sealed by divers. Suction lines from powerful pumps were then rigged up, and all the water was pumped out of the ship until it was entirely replaced by air. This caused the ship to come to the surface. But when the *Moccasin* was brought to the surface she had acquired a pronounced list to starboard.

This list was corrected by a novel operation. The ship was loaded with more cargo in the shape of broken rock. The rock was all loaded on to the port side, the side highest out of water. Gravity did the rest and brought her to an even keel.

Milk and Meat as Rivals

AS the price of meat soars upward, many people are forced to be part-time vegetarians. Thus the old question, "Is meat essential to human well-being?" arises again. The Committee on Food and Nutrition of the National Research Council has issued an interesting report on the relative value of meat and milk.

Eighteen per cent of the protein and energy of grain used in feeding a cow goes into the milk, and is therefore recovered for human consumption; whereas only three and a half per cent is recovered in beef. As for the mineral elements in hay and grain, not much is stored in the tissues, but a great amount goes into milk.

Beef profiteer, beware! The hard-pressed public may decide to let milk take the place of beefsteak.

A Multiple Spraying-Machine

An Englishman invented this spraying-machine, which looks like a strange animal. It sprays trees of various heights at once

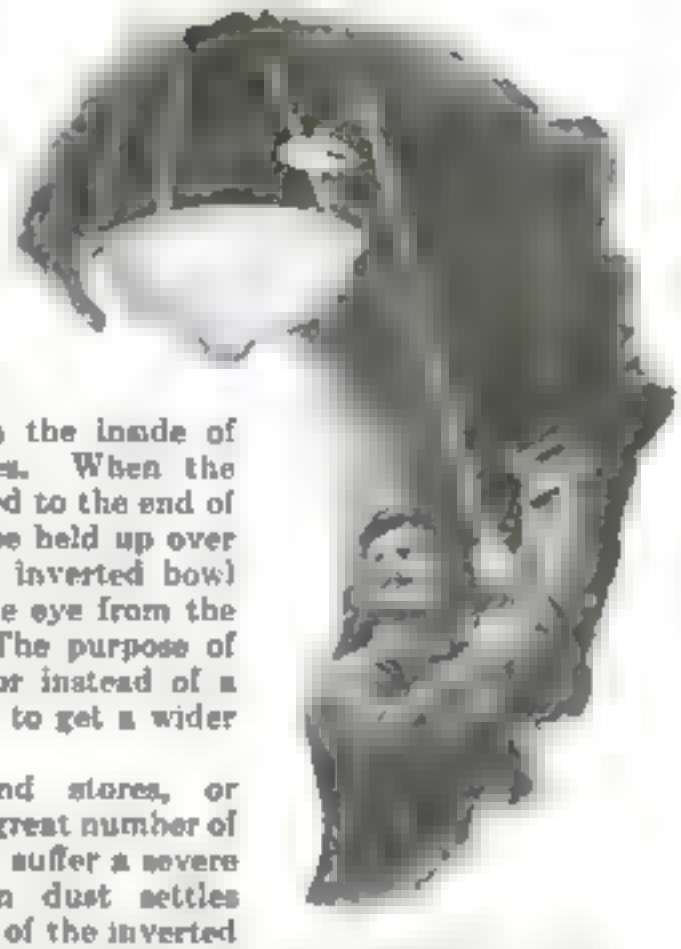
THE spraying-machine has not escaped the searching mind of the inventor, and now the multiple spraying outfit has come into use.

This machine is the invention of an Englishman. It is provided with no fewer than twenty-four nozzles. These are arranged at various heights, so that trees of different age can be treated. In the picture above only the higher nozzles are in use. A pump forces the fluid out of the many nozzles at considerable pressure. In this way, a large orchard of trees can be treated in a very short time.

The multiple spraying-machine is a formidable device in the battle the farmer is always waging on insects.

Finding the Dust with a Mirror

A CONVEX mirror of the kind mounted on an automobile to show what is coming from the rear, can be satisfactorily employed to see how much dust has accumulated on the inside of lighting fixtures. When the mirror is secured to the end of a pole, it can be held up over the rim of the inverted bowl that screens the eye from the direct light. The purpose of a convex mirror instead of a plane mirror is to get a wider field of view.



An extension pole can be used to support a convex mirror, making it easy to detect any accumulation of dust on elevated fixtures

Factories and stores, or offices where a great number of lights are used, suffer a severe handicap when dust settles over the inside of the inverted fixtures. In some instances nearly fifty per cent of the light can be lost without noticing the change that has progressed so gradually with the gradual accumulation of dust.

And the housewife, too, will find this contrivance of value, since more and more indirect lighting is being adopted in private homes. A sun afterthought, she might use this invention in hunting for articles on shelves.

Telephoning Over a Ray of Light

A SYSTEM of sound transmission by reflected rays of light has recently been developed by Professor A. O. Rankine. But it cannot be used for distances of more than fifty miles, because of the curvature of the earth.

The transmitter consists of a diaphragm similar to a phonograph sound-box, a small mirror mounted on the end of the diaphragm, a projecting lens, and another mirror. The operator talks into a trumpet that brings the sounds to the diaphragm, causing the lever and mirror to vibrate almost imperceptibly.

By means of the focusing lens, a strong light is directed against the mirror, passing through a shutter with parallel slits to split up the light. This is reflected from the mirror into the second lens, in front of which there is also a shutter with parallel slits. Since the little mirror vibrates in accordance with the sounds directed against the diaphragm, the reflected rays from the first lens to the second will not always register exactly with the slits in front of the second lens. The extent of this discrepancy determines the intensity of the beam of light projected from the secondary lens, in exact relation to the character of the sound received by the special transmitter.

The sound of the voice in the trumpet causes a mirror to vibrate and, aided by strong light rays, the voice is reproduced

At the receiving end there is another lens to gather in the beam of light, focusing it on a selenium cell in the circuit with a telephone receiver and an electric battery. Now, selenium changes its electrical conductivity when subjected to varying illumination, and hence the electric current is varied with the transmitted rays of light, the receiver reproducing the sounds just as it does in the ordinary telephone system.

The lack of strict privacy in wireless telephony is one obstacle to its complete commercial success. Messages sent become the property of any amateur who possesses a receiving equipment. Thus while the range of wireless is unlimited, its privacy, except where code is used, is impossible. In other words, no one can corner and bottle up wireless for commercial exploitation and control. Hence the great value of Professor Rankine's invention.

Making a Loop in New York's Subway System

And thereby putting an end to a nuisance

By Lawrence Whiting

VISITORS to New York—and not only visitors, but natives who have suffered confusion in stretching their necks following the black (or the green) line at the Times Square and Grand Central subway stations, will welcome a plan that has been devised to do away with the present complicated arrangement of the New York subway transfer system.

Connections between the East Side and West Side subways can at present be made only by means of the shuttle train that runs through Forty-second street.

Two Plans Are Offered

There are two suggestions that can be followed in relieving the congestion. The first is the better. The sum of $4,000,000 is estimated to be the amount required to put it into practice. The Thirty-fourth street Board of Trade puts this plan forward, designating it as the "Independent Loop." It makes use of existing structures and tracks wherever possible.

The southerly track of the old subway from Broadway through Forty-second street, which is now unused, would be the starting-point of the new system. This track is connected with a track in the Fourth avenue subway, and is unused as far south as Thirty-eighth street. It is proposed to extend this track down Fourth avenue to Thirtieth street.

In Thirtieth street a one-track subway would be constructed to connect the Fourth avenue with the Seventh avenue line. On Seventh avenue, from Thirtieth street to Forty-second street, a new track would have to be laid alongside of the present northbound local track. The present arrangement of the Pennsylvania subway station makes some changes necessary at this point. North of the station the track would run under the sidewalk, turning into Forty-second street to connect with the southerly track and passing under the Heidelberg building. A new platform would also be required.

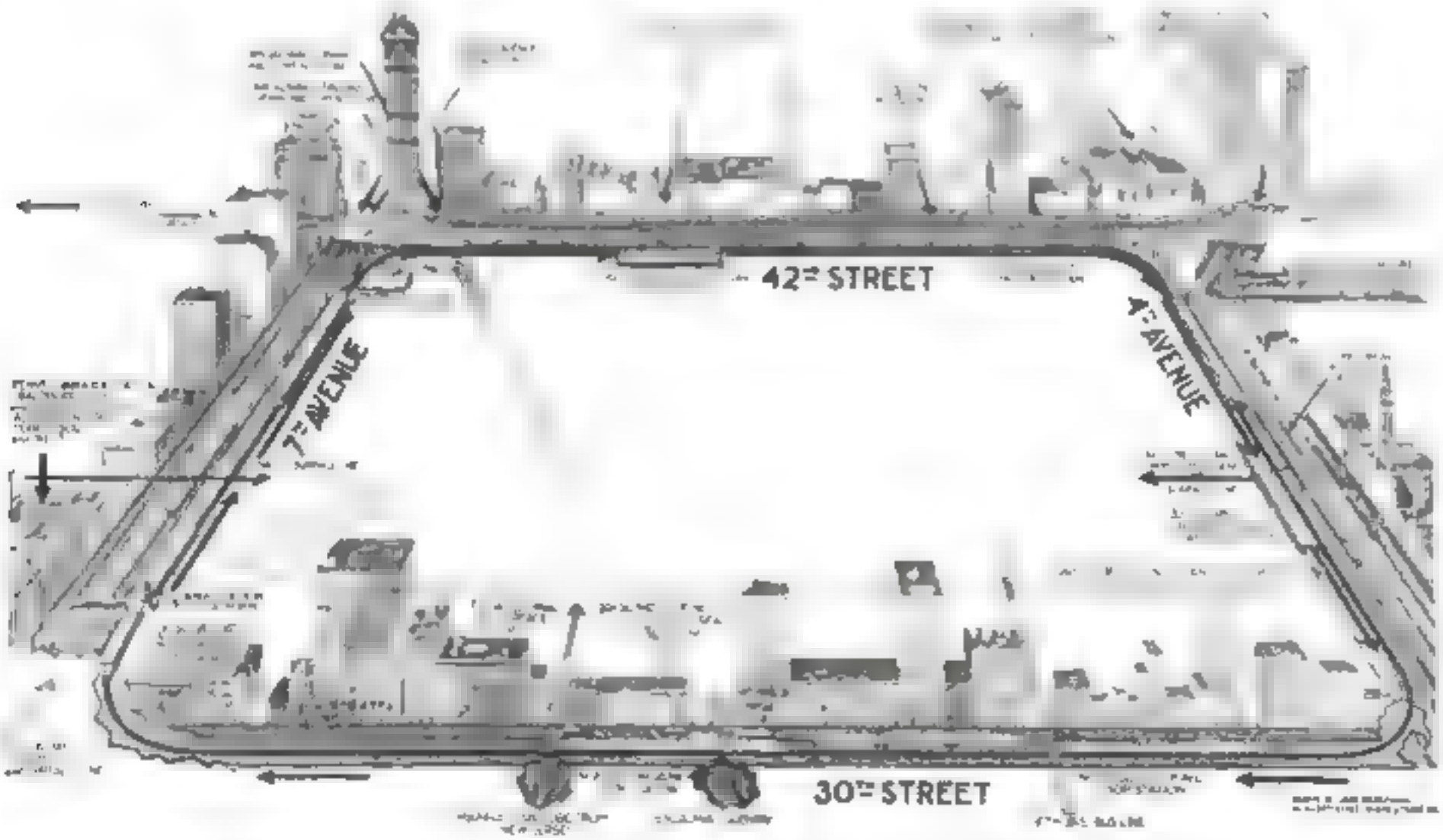
Two stations would be constructed in Thirtieth street between Fourth and Seventh avenues, one located near Fifth avenue and the other probably near the Broadway crossing. There would be two stations in Forty-second street, one at Bryant park and the other convenient both to Fifth avenue and to the Grand Central station.

The alternative plan, which is estimated to cost about $2,000,000, makes use of the present tracks of both subways, with the construction of a new single track through Thirtieth street. The schedule of the downtown local trains in Fourth avenue and the uptown locals in Seventh avenue would have to be slightly rearranged to accommodate the increased use of these tracks.

Connecting Two Great Terminals

Trains would be operated by running them south on the Fourth avenue local line, then west through the new Thirtieth street subway, and north on the Seventh avenue local tracks to Forty-second street, then east to Fourth avenue, following the present line of travel. The number of loop trains would be limited by the local southbound and northbound traffic.

One can see the advantage of either of these plans. It provides a direct connection by subway between the Grand Central station and the Pennsylvania terminal. Within these districts are the leading hotels, retail stores, and passenger railroad terminals. The plan would also provide an easy means of transfer between the two subway systems of the East and West side.

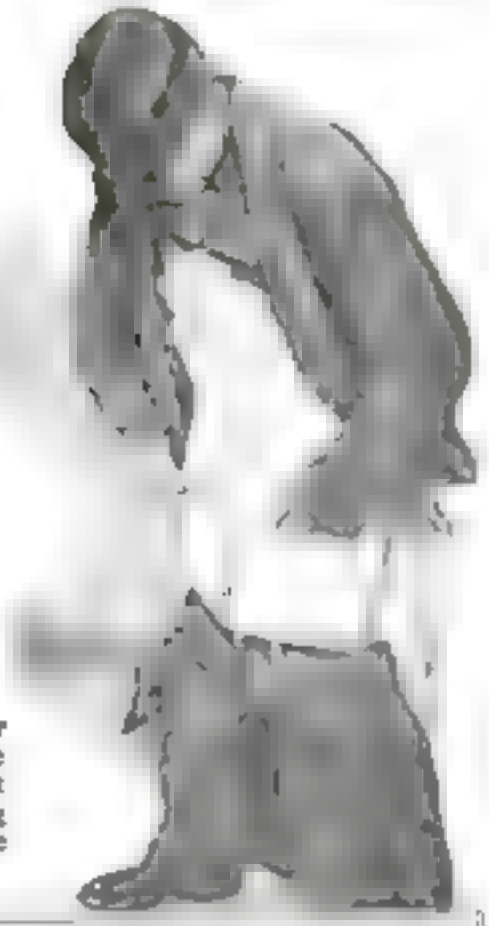


New York's proposed subway loop, providing more transfer platforms. The chief feature is the use of the present subways with the construction of but a single track and the extension of one other

Sneak-Thieves in Overalls

Disguised as honest dockmen, they pilfer from the very ships that give them work

This thief doesn't specialize in any particular line of pelf. He takes anything that happens to be lying around loose, and conceals his ill gotten gains in a money belt



Men don't usually wear corsets—particularly the overalled class—but this fellow, after stealing them, wears them home under his overalls

Sugar is this man's specialty. He conceals it in [illegible] overalls until he [illegible]

Tap, tap, tap. He's [illegible] water bag with the forbidden liquor

When his hot water [illegible]

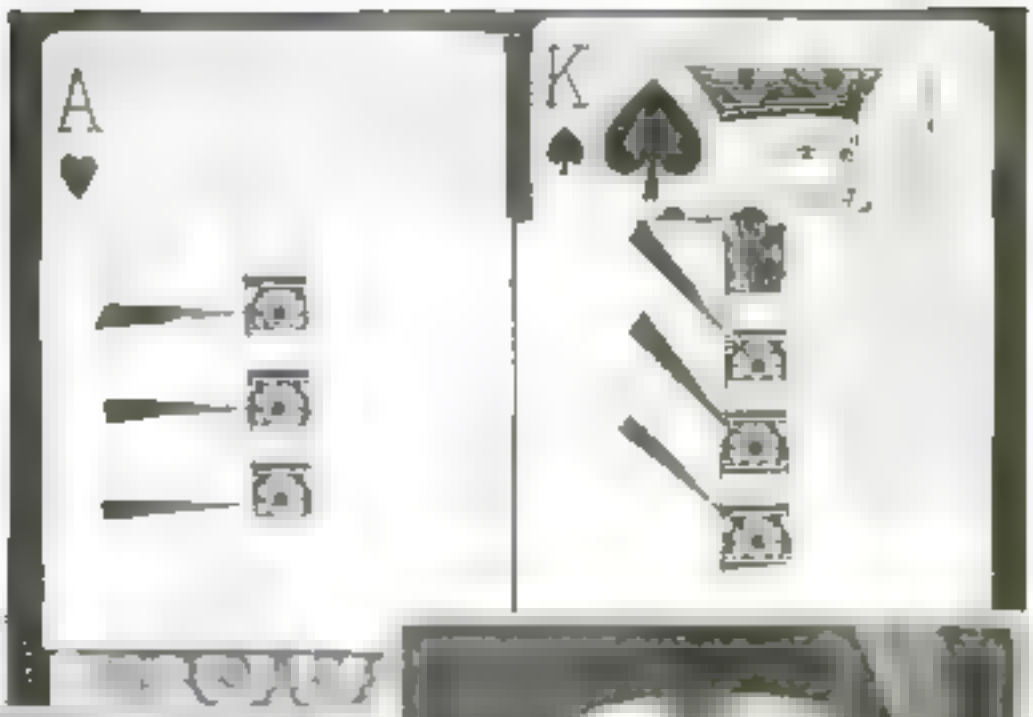
This man wraps draperies about his [illegible] but he doesn't use [illegible] Many [illegible] stolen feed the docks in this fashion

[illegible] A [illegible] place until the pilferer arrives at some secret spot where he may unload

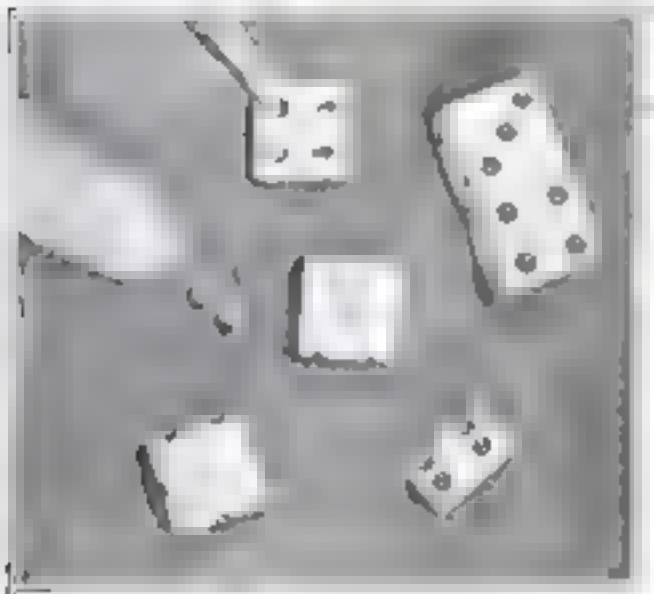
Beware of These Age-Old Tricks of Crooked Gamblers

Marked cards, loaded dice, and other devices of the unscrupulous

Courtesy of The Universal Science Magazine



Study the design of the deck that the professional gambler holds! Note the slightly varying widths of the design. If the first space is of the greatest width, that card is an ace. If the second space is the wide one, it is a king; if the third space, a queen; while the fourth space proclaims a jack.



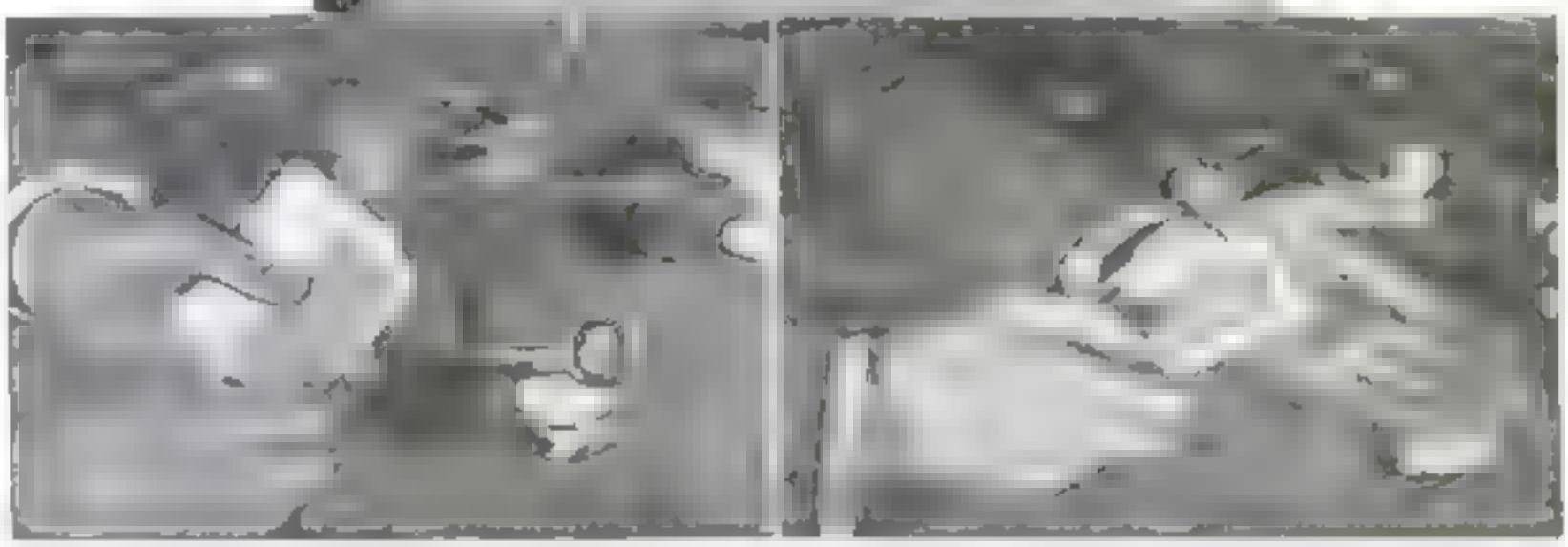
Here are loaded dice. Shots of lead placed in the right position inside the "ivories" always adjust the falling dice so the lucky "seven" will turn up, after they roll out of the box.

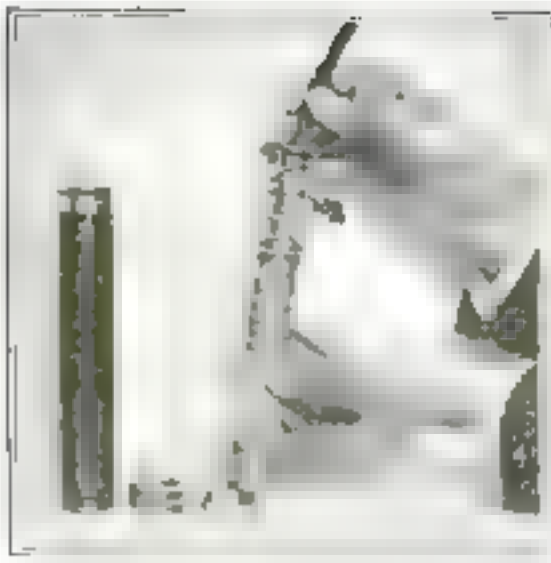
Here is the "shell game" exposed! Of course the pea is not under the cover [illegible] because [illegible] skilfully [illegible] Notwithstanding [illegible] simplicity, this trick is still deceiving many people.

Fred Keating, master magician, holds a hand from which he can pick the aces. One way of identifying them is by slightly "crimping" their corners.

An unused pipe is an effectual aid when it has a small [illegible] bowl. The image of whatever card he deals is thrown to his partner, and the latter decides what to play.

A highly polished signet ring is a dangerous opponent. The gambler turns the ring so that a certain card is reflected toward his partner, thus [illegible] what card to play to win the game.





You Can Recharge Your Own Flash-Lamps

MOST pocket lamps have [illegible] they are always burning out. An English company has put [illegible] market a wet battery lamp [illegible] burns steadily for [illegible]

[illegible] recharge it by connecting it with an electric circuit. The plates are [illegible] and a positive pole at [illegible] New [illegible] positive pole there is a small [illegible] which is screwed to [illegible] sulphuric acid. When the battery needs recharging, the poles are connected with a three-ampere circuit and left for several hours.

A Chinese Water-Clock

BEFORE the Occidental clock found its way to China, a cumbersome water-clock was used. It consisted of four buckets placed on four steps and connected by chutes. The top can was filled with water.

From can to can the water trickled until it reached the bottom can. A ruler protruded from an opening in the lid of this bottom can, and the ruler rose as the water rose. There were time marks on this ruler and thus the Chinese told the hour.

Anchoring Bricks to the Side of a House

C[illegible] removed and the anchor remains, imbedded in the concrete.

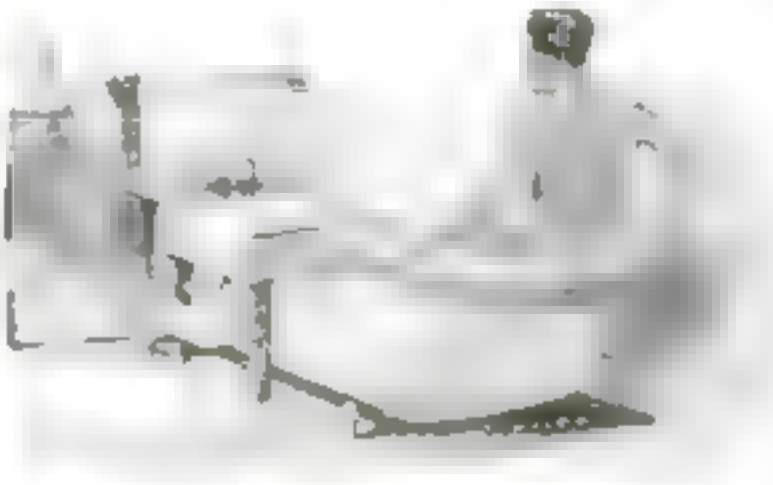
When the outside layer of bricks is applied, S-shaped hooks made of spring-steel wire are fastened under the edge of the anchor which has been pried up. These bind the bricks.

This anchor is also used to fasten tile wainscoting in place. In that case the wire forms a mesh.

Paper Kept Under the Counter

IN most stores wrapping-paper rolls are placed in stands that block up much of the counter space. And every time the clerk wishes to wrap up a package, he must reach for the paper. But now there is a new paper-cutter and -holder that fits under the counter and is invisible except for the cutting-edge.

It is entirely out of the way when not in use, yet it is right there when the clerk wishes to use it. He pulls at the thin edge of paper that appears beyond the blade and then tears it off when he has had enough. The picture below shows a man using one of these paper-holders and -cutters, and how space is saved.



The Bench Legs Fold Up Inside

A BATH TUB seat, a seat attached to the foot of the bed, or a shelf attached to the wall—this is the invention of Mr. George S. Stuart, of Washington, D. C. It is composed of a wooden box open at the bottom and arranged to accommodate the folding legs when not in use.

How do you open it? By placing a hand in the slots and swinging the seat up to a horizontal position, then the spring will swing the legs to a vertical position and a cord will prevent them from being swung outward too far. A clamp screw permits the legs to be adjusted to the proper length required for a bed, a tub, or a shelf.

Heating with an Electric Fan

DON'T know when you will get your coal? That needn't worry you, for an electric heating-fan has been invented. The heater may be attached to any electric-light socket. When the current is turned on, coils within the heater grow red hot, and a small fan sends the heat out into the room.

All the heating and blowing mechanisms are carefully enclosed in a non-heating case. Thus, when the fan is sending out blasts of hot air, you can put your hand on the case without burning it at all. In summer the fan part of the device may be used for cooling the air. This is made possible by two switches.

He's Catching Frogs for Dinner

WHEN you consider the fact that the Chinese eat sharks' fins, sea-slugs, ducks' tongues, deer's sinews, and pickled fir-tree cones, it is not at all surprising that they eat frogs too. They do not stop at frogs' legs; they eat nearly all of each frog. And they eat 'em boiled, fried, broiled, minced.

How do they catch their frogs? By means of nets similar to the one shown above.

The frog-catcher stands at the edge of the water with his net in his hand. When his victim hops on a stone within reach, he swoops down, catches the frog in the meshes of a large net, and then takes him off, placing him in a basket.

A Doorknob with a Secret Combination

ONE of the faculty members of a dental [illegible] ted the trick doorknob shown above. When a prying patient rattles the knob [illegible] thing happens. But when a faculty member grasps it, the door opens easily. He knows the trick.

The knob and its stem are separate sections. The first and second fingers are placed around the stem, as shown in the illustration. By pressing the stem and knob together, they are brought into con[illegible] and the latch act-

How Deep Is This Crevasse?

IN the state of Washington there are ten large national parks. Chelan Park is one of them, and it is a favorite place for tourists. The Lyman Glacier is located in the park, and many visitors climb it every year. There are deep mysterious crevasses in the glacier, caused, most likely, by irregularities in the bed of the glacier, also its variable movement.

The picture below shows some daring tourists getting as near as they can to the crevasse without falling in. One of them has even spanned it. The glacier itself is a mile and a half square and moves very slowly. The surface rises gradually and walking on it is comparatively safe.

Their Queues Are Made of String

THE Wakamba brave wears a pigtail. Just like the Chinaman? No; the Chinaman's queue is of real hair, whereas the black man's is made of string. His hair is short and fuzzy, and he ties the string to it. To cover up the connection, he wears a funnel.

Why does he go to all that trouble in order to have a string hang down his back? Just because it's the custom. Perhaps if the Wakamba native saw a picture of you wearing a stiff white collar, he would wonder why you were trying to choke yourself.

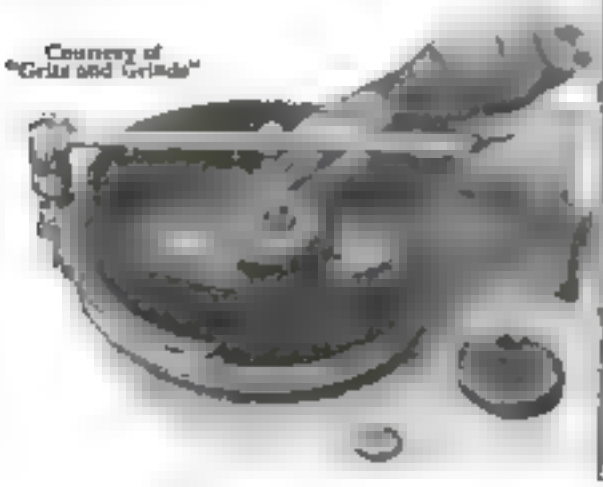
Incidentally the Wakamba women wear steel stockings and armlets, and are sold for a few cows.

Grinding Lenses by Machine

DID you ever wonder how lenses were made? First, the molten glass is cast into shape. Such pieces are called "blanks."

The blank is fitted to an iron block with pitch or wax. It is then placed in the rapidly revolving bowl, and held by a steel pendil that fits into a hole in the center, making the blank revolve by friction. The surface of the bowl is kept covered with a mixture of fine abrasive powder and water. As the blank revolves, these abrasive particles take bites out of the glass surface. This operation is repeated, until the surface is thoroughly polished.

Courtesy of "Grits and Grinds"



It Grows with Your Business

A DESK littered with letters, memoranda, and other data is most unsightly. Keep them, rather, in an expanding desk-file like the one shown below. Each compartment is a separate unit. You can add as many units as your need dictates. If you index each compartment and keep the proper items in it, you will avoid confusion and the possible loss of valuable data, to say nothing of the time saved in being able to immediately locate them.

The necessary bolts and rubber supports go with each unit. Thus you can add to your file from time to time as you need new space.

Making It Easy to Copy a Picture

SEE how well you can copy pictures from the magazines you read. Go about it [illegible]

Place the picture you would like to copy on the table, and [illegible] opposite it put the [illegible] on which you are going to copy. Between the picture and the paper place a piece of plain glass mounted in a frame so that it will stand vertically.

By looking through the glass on the blank paper, the picture to be copied will appear, and all you have to do is trace the reflection.

A Concrete "Log" Cabin

LOG cabins are very nice for the summer, but when old Jack Frost puts in his appearance, the comfortable modern home with its conveniences is the place to live.

A man living in Yankton, South Dakota, liked log cabins so much that he built his home to resemble one. He used concrete "logs." They were all of a size, since they were all cast in the same mold. The logs were made with interlocking ends so that they fitted together just like real logs. The foundation of the house is made with prairie rocks.

Swayed by Summer Breezes

THIS granite pillar shivers in the wind. The slightest breeze rocks it gently to and fro. The great column is almost perfectly balanced on its pedestal. So perfectly that it is sensitive to the smallest atmospheric disturbances. The shaft is over one hundred feet high with a diameter of but twelve feet at the base. When rocking, it moves from two to three feet at the apex. The base rests in a small hollow about three feet deep.

It is almost a certainty that erosion will cause the shaft to fall some day, but just how soon, no one knows. When it does fall, there will be a great crash in the neighborhood of Garden Park, Canon City, Colorado, where it is located.

Sketching on Fungus One Artist's Hobby

EVERYTHING in the world has its use—even shelf fungus. Its [illegible] hard, white [illegible] surfaces can be [illegible]

Any sharp-pointed instrument will cut into the surface.

When next you go to the country, etch some scenes on this fungus, or try your hand at portraiture—if your friends raise no objection.

If they turn out well, give them away as Christmas or birthday [illegible]

A New York artist, Mr. A. Zipprich, has made fungus etching his hobby, and he has done some very delicate work.

Sampling the Soil

IF you are out in the country and see a man get out of a buggy, tie his horse, and take a long auger with which he drills a hole in the dirt-bank at the side of the road, do not be hasty in passing judgment and think him a lunatic.

This man is probably an expert sent out by the Bureau of Soils of the Department of Agriculture.

With the auger he drills into the ground and collects a sample of the soil below the surface. This material is bottled, labeled, and analyzed.

Trees Help Old Home Folks

MANY people followed Horace Greeley's advice and went West to grow up with the country. The West is largely populated with people who were once Easterners. Every year these eastern Westerners hold state picnics, where they go to meet the people from their own home state and town. In this way many happy friendships are kept alive.

John Jones, who is now married and has seven children, meets Sadie Smith, from Peoria, Illinois, who used to be his sweetheart. Sadie and John worked in a cannery years ago and it is enjoyable to get together to talk old times over.

Sadie and John met again by signing their names and addresses to lists that were posted on the trees in the grove where the picnic was held. When people arrive at the grove, they read the posted lists to see if any of their old acquaintances are present. In this way, the picnic is really a huge get-together.

Carry Your Rubber Heels with You

YOU start out in the morning and the sun is shining; you come back at night in the rain—feet dripping wet. Yet you can't very well carry rubbers with you every time you go out.

Now, however, there is a new heel-rubber that you can put in your pocket. When it rains you take out a pair, slip them on your heels, and proceed secure in the knowledge that at least part of your shoes will remain dry. In winter, when there's ice on the ground, these detachable heel-rubbers will keep you from slipping, according to the inventor.

They would make also a good substitute for rubber heels, with the added advantage of making you independent of the cobbler around the corner.

The Poor Man's Airplane

AUTOMOBILES are made for poor [illegible] why not airplanes? The R[illegible] brothers of Italy have developed a mach[illegible] that could be sold at a reasonable price.

The little triplane is said to be the smallest flying-machine ever built. Its span is only eleven and a half feet. A forty-horsepower engine gives it a speed of seventy miles an hour, which it can continue for four hours—or from New York to Boston—without stopping. With a length of twelve and a half feet and a height of seven and a half feet, it is possible to keep this machine in a garage.

This airplane, although small, is an all-round machine. It eats up the gas, makes a lot of noise, and can be used for "stunting."

In some respects it is more efficient than larger machines. It can leave the ground at a speed of twenty-five miles an hour. It weighs three hundred and thirty pounds and is capable of lifting that much weight.

A Hand-Loom for the Convalescent

THE next time you are taken ill with a cold or the measles, weave belts in bed to pass the idle hours away.

This little hand-loom is extremely simple to manipulate, and attractive designs can be produced on it.

It can be constructed in a few minutes with a few tools, and the results obtainable are surprising in every way. Hand-bags, trimmings, and hat-bands can also be made by its use.

The little patient in bed, in the picture below, is weaving a belt on a hand-loom that her daddy made for her.

Reducing the Glare of Electric Light

CONCENTRATION of light in a small area, such as in the electric arc and filament, produces a brightness which greatly harms the eye.

It does slowly what a few minutes of direct gazing at the sun would accomplish. We realize now that direct rays from an unshielded illumination are bad for the eye, hence this ray-diffusing device with as little loss of illuminating power as possible. The new eye-shield device effectively achieves this result.

Pencils with Their Own Night-Lights

WRITING in the dark is evidently often practised, for two self-luminous pencils have recently been invented.

One comes from England. It has a battery, a light bulb, and a glass case that fits over the pencil to protect the bulb.

The American invention, patented by Philip S. McLean, is simpler. It provides for a shield lined with self-luminous material. The shield, adjusted by a spring, may be attached to any pencil.

Making House-Wrecking Easy

HOUSE-WRECKERS recently saw a new tool tested, which is designed not only to save time, but also to prevent the lumber from being split prying it apart.

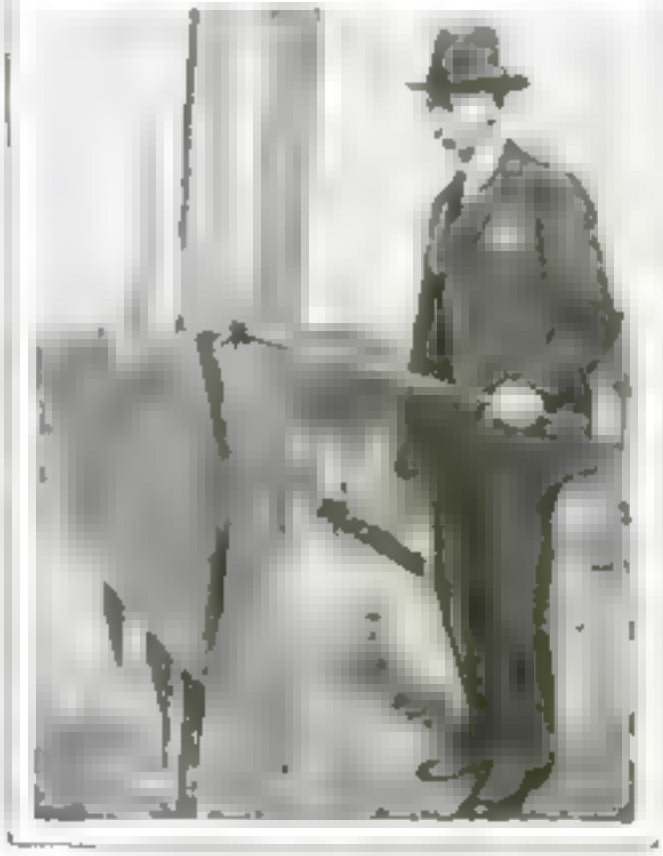
The invention is that of a carpenter, William Henry Rich, of Wrentham, Massachusetts. It consists of a handle twenty-six inches long, one end of which terminates in a wedge-shaped part. The opposite end has a claw and a metal connecting bar

When a board is to be pried from the support to which it is nailed, the head of the tool is placed under it. The leverage of prying is increased, and the pressure is distributed by the balance this "double-pronged" head affords.

Raise Your Cap and Comb Your Hair

"CHARMED," you say as you take off your cap in deference to the newly introduced. But, alas, your hair is all mussed up and you are a sorry sight. To remedy this, Alva Dawson, of Jacksonville, Florida, recommends the "combined head-covering and hair-comb" that he has invented

It is a cap with a comb in the peak and a small stud for moving the comb back and forth. When you raise the cap, you push the stud backward, and the comb plows through your hair Of course, to get the best results, you ought to wear your hair pompadour style.



Reading Can Be Enjoyed When Wearing This Headlight

OFTEN you may wish to make notes with pencil and paper, or to read when suitable illumination is not at hand. Then the "head-lamp," invented by Charles S. Burton, of Oak Park, Illinois, becomes serviceable.

It consists of a bulb and socket connected with a battery which can be carried in the pocket; a shade to protect the eyes from the rays of light; and a reflector to throw the rays downward upon the book or paper held in a position for reading. The reflector and eye-shade are designed to be folded together to protect the lamp when not in use.

A Centralized Rivet-Heater

INSTEAD of having to start the forge fire, carry coke, and heat the rivets separately here is a device by which a number of rivets can be brought to a working heat at once

Oil furnishes the fuel, and the rivets are placed in a compartment in which they are all heated together, and delivered, ready for the workman, instead of having the workman wait for them. From the furnace to the works the rivets can be conveyed by small motor-truck or aerials in from two to five minutes. They will retain their heat one and a half hours.

Shipbuilders, boiler-makers, and builders of steel structures will all benefit by this invention.

This Spoon Acts as a Straw

YOU don't need a straw with this drink, or that ice-cream soda. The handle of the spoon, being hollow, serves as a straw. Eat the ice-cream or the crushed fruit with the spoon, then draw up the delicious liquid through the hollow handle.

The spoon is made entirely of glass, and at the back of the bowl there is a small opening through which the liquid is drawn.

Be careful, though, to prevent the small tube from becoming clogged.

Run Your Own Side-Wheeler

THE side-wheeler, though obsolete as a steamboat, is quite new as a hand-propelled craft. A satisfying speed can be made in this boat and it can be managed with little trouble, hence the new invention is very popular

A crank in each side turns the wheel by a simple arm movement, and the boat can be sent on a forward, backward, or a turning course at will

Walter Johnson, of London, England, is the inventor. The boat is known as the "paddle-boat," and it provides all kinds of sport on pond, lake, or stream.

In England the side-wheeler has become a keen rival of the punt and the rowboat, owing to its speed and ease of manipulation.

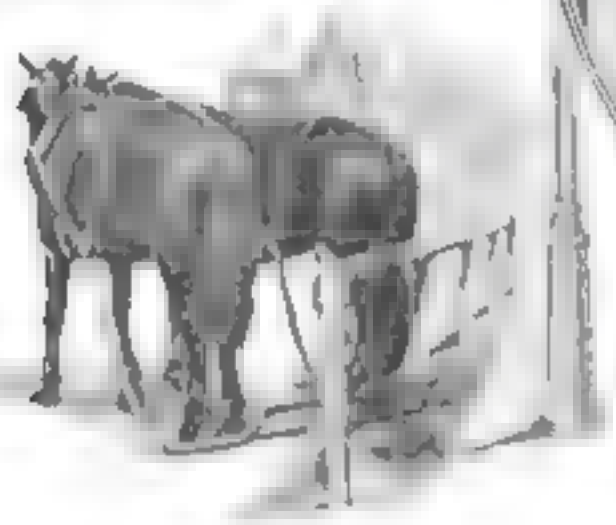
To Hitch Horses Humanely

LONG iron rails have been installed along the wharves at San Francisco for hitching the big truck-horses left standing by teamsters

The traces are fastened to a long stout bar, and the horse stands as if hitched to a wagon. The reins from the bit are also tied to the bar. This probably leads the horse to believe that it is merely waiting to be driven.

The use of the hitching-post, or a weight, keeps a horse's head in a more or less confined and cramped position, and is less humane than this new way

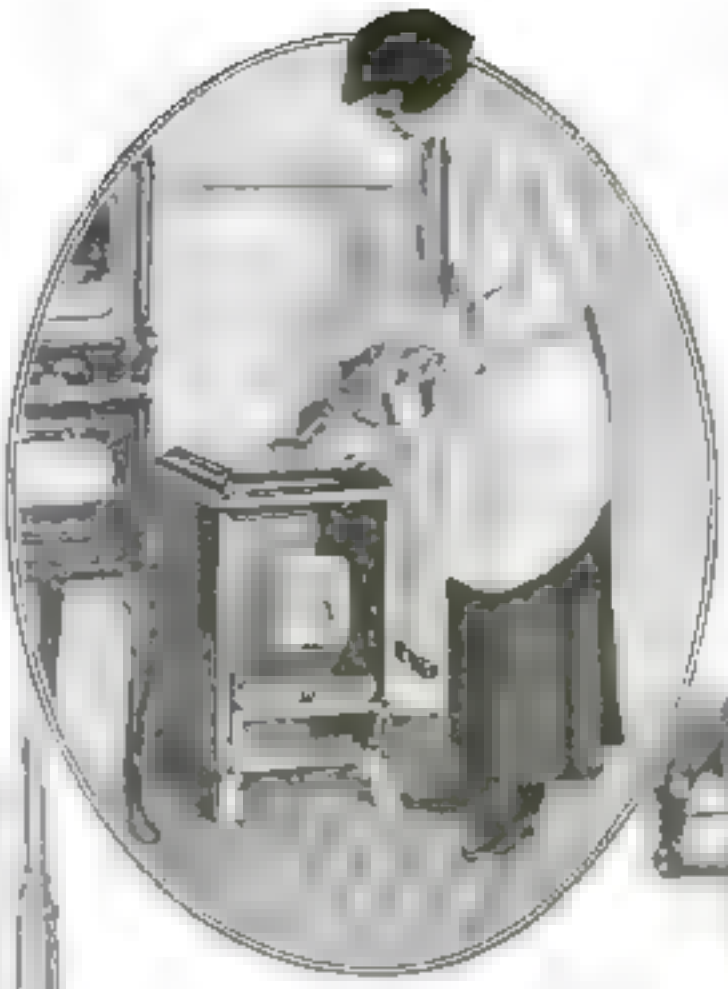
The horse is such a universally beloved animal, that this device will be welcomed.



Freeze Milk and Find the Water

A SPECIAL apparatus has been constructed by Dr Hortvet, at the laboratory of the Minnesota State Dairy and Food Commission, by which the amount of water contained in a sample of milk is determined by the milk's freezing-point.

The unadulterated milk of a healthy cow freezes at thirty-one degrees Fahrenheit. The thermometer used contains a scale of each degree so greatly magnified that minute fractions of an inch can be read with a [illegible] The point at which the mercury stops is the milk's temperature



An Odorless Garbage-Burner

USUALLY one does not like to burn garbage near the house because of its disagreeable odor. Now comes a home garbage-burner, which is placed beside the gas-range

It is gas-burning, and has a draft to carry away all the unpleasant fumes

Correcting a Cow's Bad Habit

STRANGELY freakish as it may seem, some heifers feed upon their own milk, thus depriving the farmer of the valuable product. J. Luther Emerson, of Frankfort, Kentucky, has patented a "cow-weaner" that breaks this habit

The weaner has a stiff collar that fits tightly round the cow's neck and is so arranged as to prevent the animal from reaching around. One large bow encircles the portion of her neck near the shoulder, while a smaller one embraces the neck near the head. The two bows are joined together with two V-shaped strips of metal, extending six or eight inches beyond the rear of the bow

This New Sadiron Is a Roller

IT took Abraham Max Holtzman, of Brooklyn, New York, to discover from experience that a new style of iron would be a relief to the presser, so he invented one.

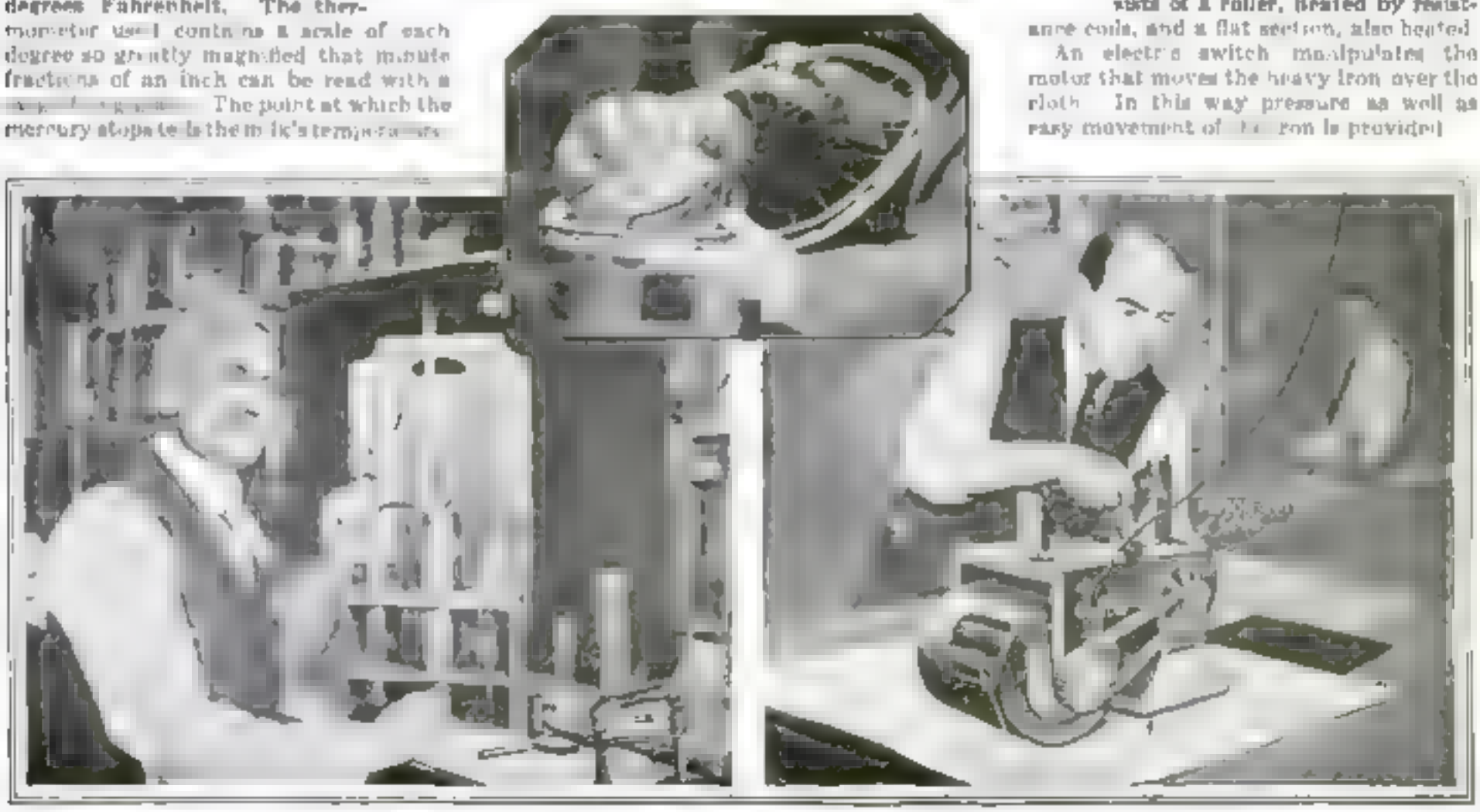
With the ordinary light iron, all the pressure that counts is the strength of the man who moves the iron. The new sadiron consists of a roller, heated by resistance coils, and a flat section, also heated

An electric switch manipulates the motor that moves the heavy iron over the cloth In this way pressure as well as easy movement of the iron is provided

A Fettered Watermelon

THIS watermelon got mixed up with an old bicycle wheel when it was young, and it grew up fettered with the wires. Although its shape was affected, its size was normal and its flavor was not impaired

"Warmed by the sun and wet by the dew," the watermelon grew, despite the resisting wires. One of the spokes can be seen on the point of breaking.



New Jobs for the Old Wax Figure

GONE is the lay figure with the far-away stare and the painted black hair that glistened like patent leather. Gone, too, the ill-fitting suit of hand-me-downs, marked "Take me home for $10," that the figure used to wear.

In its place is a lifelike wax figure displaying its expensive clothes with aristocratic carelessness and epitomizing what Broadway considers "class" in beauty

Keeping Up with the March of Science

Facts for the man who wants to know

Cold-Storage Fish

COLD-STORAGE eggs have been found to be palatable. Now we are presented with cold-storage fish. Those who have already eaten some say that it tastes just the same as fresh fish, and chemists say that the food constituents of the fish do not seem to be affected by the months of freezing.

If the fish are frozen promptly when they are caught, they will remain the same for at least a year.

Many Shoes Made from One

WHEN a Mexican automobile refuses to wear an old shoe any longer, the shoe is sold for a few cents to a poor native, whereupon he and his family wear it.

He cuts the shoe into thick soles which vary according to the size of the family's feet, thus out of one shoe he makes many. They retain their natural shape and are bound around the feet with thongs. In rainy weather non-skid shoes are worn by some of the more prosperous natives.

Davy Jones' Rich Cargo

A DIVER was sent down recently at New York to locate a case of machinery that had fallen into the river. As soon as he reached the bottom he signaled that he wished to come up.

When his helmet was removed, the first thing he said was, "What's the number of the case?" There were so many cases at the bottom of the river that he didn't know which one belonged to his employers. The amount of cargo that is lost in loading and unloading ships is enormous.

Use Your Weather Man

THE American Meteorological Society has formed a Committee on Corporation Membership to bring before professional and business men the reasons why they should become patrons of the society.

The more funds the American Meteorological Society has, the better it will be able to carry out its aims, especially in fostering meteorological instruction and research. Are not the possibilities of being able, for example, to make seasonal forecasts, or to predict the path and speed of a West Indian hurricane, or to know beforehand where and how much snow will fall in a winter storm, worth the expenditure of considerable sums of money?

A Three-Handed Watch

NEW YORK state has two kinds of time—railroad time and daylight-saving time. There is an hour's difference between the two, and travelers find it hard to remember which is which.

Mr. E. A. Bernard, a watchmaker of Little Falls, New York, would solve the problem by riveting a second hour-hand to the original one so that they are spaced exactly one hour apart. He would paint the new hand red, label it, and thus eliminate confusion.

Turkish or Greek Tobacco?

MOST of the tobacco for which Turkish cigarettes are famous is really Grecian tobacco, grown in Grecian Macedonia or in other parts of New Greece, namely Cavalla, Xanthy, and Yaka, as well as Thessaly and other parts of old Greece.

The little real Turkish tobacco in use comes from Samsun, Trebizond, and the coast of the Black Sea. About eighty per cent of the tobacco in so-called Turkish cigarettes is Macedonian or Grecian, and only about twenty per cent Samsun.

This doesn't mean that cigarette-makers lie about their tobacco, but simply that Turkey has been losing her possessions to other countries, and among them important tobacco-growing areas.

Evidently tobacco does not follow the flag. Since a rose by any other name would smell as sweet, "Turkish" cigarettes sold as "Greek" ought to have just as fine an aroma. If we must think of tobacco geographically, then let us call it by its right name.

Safety of Acetylene Gas

IN the oxyacetylene-welding flame the combustion of the gas (acetylene) is thorough and complete by reason of the flow of pure oxygen used in burning it. Even if this were not the case, the welder might inhale a mixture of acetylene and air without encountering any injurious fumes.

George Gilbert Pond, Ph. D., professor of chemistry at the Pennsylvania State College, in his excellent bulletin on calcium carbide and acetylene, reassures his readers with the remark that acetylene gas is "so free from deleterious quality that leaving a jet open in a living-room for a week involves no peril to human life."

The "deadly fumes" arising in brass welding, where these have not been prevented from escaping by the use of proper fluxes or welding-rods, are due to vaporizing of the zinc contained in the brass. Brass is approximately sixty per cent copper and forty per cent zinc. When heated to a point of fusion, unless proper precautions are taken, a part of the zinc will escape in the form of white smoky fumes, the chemical term for which is "zinc oxide." Brass will give off these fumes at a fusing temperature, if an effective preventive, such as the proper flux, is not employed, no matter what the source of the melting heat.

Oxyacetylene is generally used in the fusing and welding of metals because of its convenience, economy, and its remarkable property of localizing a sufficient intensity of heat within the range of the work to which it is directly applied.

Renewing Old Automobiles

THE more expensive automobiles are characterized by a fineness of workmanship that their owners little appreciate. Parts sometimes fit together with an error of only a ten thousandth of an inch. The result is wonderful smoothness of running. But when the parts wear away they must be scrapped—at least, that has been the practice in the past.

Major B. M. Thomas, of the British Institution of Automobile Engineers, now calls attention to a method of saving much of the money that scrapping entails by a new method of building up the worn parts by electro-deposition. A worn part is plated with a layer of metal that is not only hard, but that needs no heat treatment. A little grinding, and the part is ready to be installed. The plating forms an integral mass with a part on which it is deposited so that it cannot be separated. The plating can even be case-hardened; it penetrates into the metal beneath.

Owners of motor-truck fleets, whose repair bill for new parts must run into the thousands during the year, will now be able to save money.

Mosquitoes Dislike Swamps

RECENT experiments prove that, contrary to the general belief, mosquitoes do not thrive and multiply in foul, stagnant water. In fact, mosquito larvæ actually lose vigor and die when surrounded by decomposed vegetation.

Whether this is due to bacterial action on the larvæ or to an excess of injurious gas due to the decomposition, has not been ascertained. At any rate, swamps are not guilty of encouraging mosquitoes, and clearing these swamps does harm.

Wood from Dead Trees

WOOD that is cut from sound dead trees—is it as good as wood cut from live ones? Many buyers are prejudiced against dead wood, but there seems to be no reason for it. The Forest Products Laboratory says that there is no way of distinguishing the dead from the live after the trees are sawed into lumber.

Of course, dead trees that have been allowed to stand too long are apt to become decayed or infested by wood-boring insects. But trees that have been dead only a short time yield strong, lasting lumber.

The Steel Slug that Exploded

ONE day an employee of an electrical manufacturing company whose job it was to superintend the hardening of slugs of Sanderson carbon steel—used as plungers in making genelite, a new self-lubricating metal—drew a slug out of the electric furnace, quenched it in a tank, and then

held it in his left hand. As he was about to test the hardness of the slug with a rasp, his attention was distracted.

At that moment the end of his rasp tapped the flat end of the slug. It flew to pieces with the crack of a pistol. One piece grazed past his ear, another flew straight up, and the remaining two dropped back in the tank.

What is the explanation? Probably the slug, which was about four and one half inches long and four inches in diameter, cooled a degree too quickly on the outside, so that the heat-expanded core exerted a surface tension so unusual that the slightest touch at the exact moment produced a violent fracture. There was evidence of core strain in the fragments. This is a unique accident.

New Uses for Damaged Fruit

WHEN such stuff as garbage can be made over into useful products, why can't damaged oranges and lemons be put to good use?

There are already several by-products of the orange and lemon, but the California fruit-growers are looking for more.

Culls—as the damaged fruits are called—are rich in oil and citric acid. They should be worth nearly as much as their more healthy brothers.

A research laboratory has been established at Corona, California, to find new uses for culls.

Hath Music Charms?

DO all animals like music? The best way to find out is to go to a zoo with a musician and stage a recital. Recently a violinist played for the animals in the London zoo and the effect of his music on the various animals was very interesting as an experiment.

Snakes, lizards, and scorpions were the most appreciative; some of them wiggled and swayed; others crept up close to the violin and listened, enchanted. Bears, sheep, wild hogs, bisons, and zebras were all mildly interested. But the wolves, foxes, and elephants fairly snorted with rage.

The monkeys were divided in their sentiments: some nodded eagerly, and listened, others scowled, and turned away disgustedly.

The Menace of Dope

HOW many drug addicts are there in the United States? Estimates vary from 200,000 to 400,000. According to the committee on the narcotic drug situation in the United States, all estimates are to be distrusted. Thus in July, 1919, there were 6741 registered drug addicts in the greater city of New York—many fewer than the actual number.

But, however incorrect the estimates may be, they become alarming when they are analyzed.

Thus twenty-three per cent of 3500 registered addicts in New York city proved to be chauffeurs, motormen, and drivers. That throws a ray of light on the real menace of narcotic drugs.

What Frightens Fish

"STOP talking—or you'll scare the fish!" Many a fisherman has whispered this. Is it really true? Can the fish hear your voice?

Experiments have satisfactorily proved that sound made in the air is almost entirely reflected when it reaches the surface of water; therefore it is doubtful whether fish can hear even the loudest shouting.

What does disturb them when you talk is the usual accompanying movements. If you move your feet slightly when you speak, the noise your feet make against the bottom of the boat is plainly heard by the fish in the neighborhood. After sitting still for a length of time you are apt to relax and move your body slightly. The fish hear every little movement through the bottom of the boat.

Everybody Flying in England

IN spite of England's recent airplane sales, reports show that her civilian flying is increasing faster than ever before. More than four hundred commercial airplanes are now in use; in six months' time they have carried more than sixty thousand passengers.

In America, aviation is still considered a daring sport by most people. Commercial flying is almost non-existent; and very few people have flown at all. Yet statistics have proved over and over again that the number of airplane accidents is no larger, proportionately, than automobile and railroad accidents.

Why is this country so far behind England in the air?

When Aluminum Explodes

A SMALL Wisconsin town has a factory in which aluminum lip-stick containers are made.

When the lip-stick containers are polished, aluminum dust accumulates. Mixed with the proper quantity of air and ignited, aluminum dust is about as explosive as illuminating gas. A spark from a piece of wire that had somehow worked its way into the suction fan ignited the dust from the finished machines and caused an explosion in the factory. Six girls were killed and six others injured.

The only scientists who seemed competent to handle and study the case were the grain-dust explosion experts of the United States Department of Agriculture. To them the industrial commission of Wisconsin has turned for advice.

Identifying the Birds

WHO hasn't heard the story that some birds mate for life and that others return to the nest sites of yesteryear? Who was the man that first made these observations? On what did he base them?

To find out just how much there is in these familiar bird stories, the Biological Survey of the United States Department of Agriculture will continue the work inaugurated by the American Bird Banding Association. Birds are to be trapped in large numbers. Afterward identification bands are to be placed on their legs, and the birds are to be released. Subsequent discovery of the banded birds, when trapped or killed, will reveal their movements.

What Shall We Do for Wood?

NO one is more keenly alive to the shortage of paper than the publisher of a periodical or a newspaper. But even he does not realize what inroads he is making into our forests. According to Mr. C. Price-Green, Industrial Commissioner of the Canadian National Railway, the newspapers of New York city alone consume the equivalent of more than nine thousand spruce-trees daily.

And yet, it is not the printing industry that consumes the most wood. In lumber, ties, and firewood the United States uses up one hundred billion feet a year.

The total standing timber amounts to more than twenty-five hundred billion trees. Unthinkable as this quantity may appear, it will be exhausted at the present rate of cutting within fifty years. Already one half of our timber comes from Canada, and that cannot continue forever.

Potash that Contains Borax

POTASH, because of its alkaline qualities, is often put in the soil to neutralize acidity. A large quantity of it is obtained from Searles Lake, California, and now the Department of Agriculture finds that the potash in Searles Lake contains at least ten per cent of borax! Some samples showed twenty-three per cent of borax. And borax is injurious to crops.

There are several potash companies operating in the Searles Lake district and they will undoubtedly have to find a new market for their product.

Airplanes Make Clouds

SHIPS were successfully hidden from the enemy by smoke screens during the war. How about airplanes? Can they manufacture clouds and make themselves invisible too?

The Government finds that airplanes actually do create small clouds by their swift passage through the atmosphere.

A temporary condensation of the atmospheric water vapor is caused and, under favorably moist conditions, clouds are formed.

Where to Buy Wild Animals

THE wild-animal business has been principally in German hands for many years. But now England has stepped in—figuratively speaking—and is taking the wild-animal business away from her former enemy. A new company has been formed in London which claims that it can procure, within a reasonable time, any animal desired.

The animals are well cared for from the time they are captured until they reach the buyer. They are given plenty of good food to eat and are kept in clean, sanitary cages. If you want a baby rhinoceros, let us know.

More Speed for the Movie Camera

Even a cannon-ball can be trapped by this extraordinary invention of a French cinematographer

By Lawrence Whiting

THE operator of the ordinary moving-picture camera is often called upon to record the movements of a bird or an animal that is moving with flashlike rapidity

The Akeley camera is specially constructed and admirably adapted to this branch of rapid photography It has connecting joints so easy manipulated that the lens can be pointed in any direction without missing the swiftly moving image of the wild denizen of the forest. But thousands of other cameras are in use that are only occasionally called upon for this kind of photograp , and, not being adapted to such rapid following of the photographic object, the results are likely to be jumpy complete failures.

How can the ordinary moving-picture camera be adapted to this requirement when it is badly needed?

An invention of Louis Janot, of Vincennes, France, has already solved the problem of passing a film with sufficient speed through the camera to take pictures at the rate of one hundred and fifty a second or faster

Ordinarily the swift passage of the film carried by the teeth that engage the perforations on each side causes the film to tear. But this invention introduces two revolving rolls, or drums, around which the film is drawn before it is wound around the reel so that in cameras equipped for this ultra-rapid photography the film is not torn. There remains but the proper guiding of the camera to follow the object, which may be passing rapidly out of the field of view And now this problem has been settled in an astonishingly simple manner.

The camera is placed in a fixed position, and a long-focus lens, capable of giving a sufficiently large image of the bird or animal that is to be photographed, is attached to the camera by a long, flexible bellows. To support this, an extension board has to be used. In front of the lens, on a movable support, is a mirror, which can be a plane piece of glass silvered on the surface

In order to follow the reflected image, to be sure that it is projected upon the film through the camera lens, a simple view-finder is mounted in a convenient place. One operator looks into the view-finder and turns the mirror to follow the object. The image is thrown into the lens and is projected upon the film. The other operator turns the crank of the camera.

The ordinary camera equipped for motion-pictures has an extremely short focus, and this produces very small images which are only enlarged on screen in proportion to the whole field of view. A flock of birds would appear merely as a fluttering mass. the individuals too small to be seen clearly

But when the long-focus camera is used, the birds can be caught on the wing as they approach in the distance. The mirror is sighted and turned quickly to follow the swiftly flying birds as they draw near. Like a telescope it catches them when too far away to be shown with the ordinary lens of the moving-picture camera, and magnifies them as they pass overhead. The whole flock may be too large to be included in the field of view, but some of the individual members will be enlarged so that details of their wing structure can be observed.

There are educational possibilities in this invention only to be appreciated when it is tried in wild-life photography. The telephoto movie, hidden in a suitable "blind" and having its reflecting mirror properly adjusted, becomes an important part of the naturalist's equipment. Concealed among the leaves he follows the swift leap of a deer or the rapid flight of a gnu, or a zebra.

At a distance which would be far too great for distinct photography, the telescopic camera bags the game. As the speed of the moving object is magnified in proportion to the size of the image, a rapidly working mechanism is necessary to "stop" the motion in each exposure. Otherwise the bird or rabbit, or deer, would be blurred and indistinct.

The mirror device is the invention of M George E. Labrely, the French cinematographer. It can be attached to any motion-picture camera. The long-focus lens provide an enlarged or "close-up" image of the bird in flight, and this, with the extension, can be attached to the ordinary apparatus when it is to be used for ultra-rapid photography.

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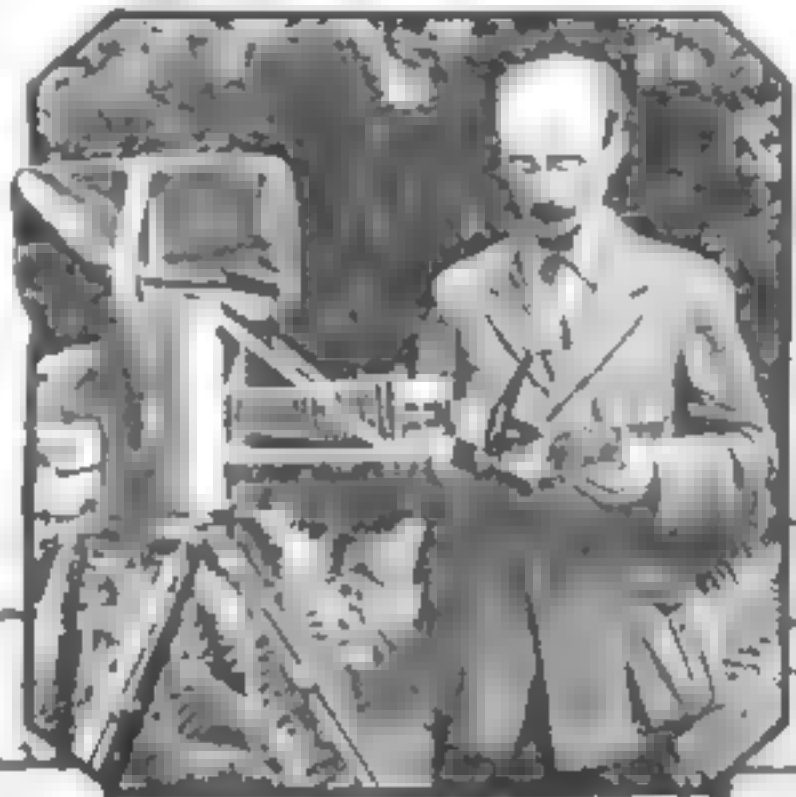
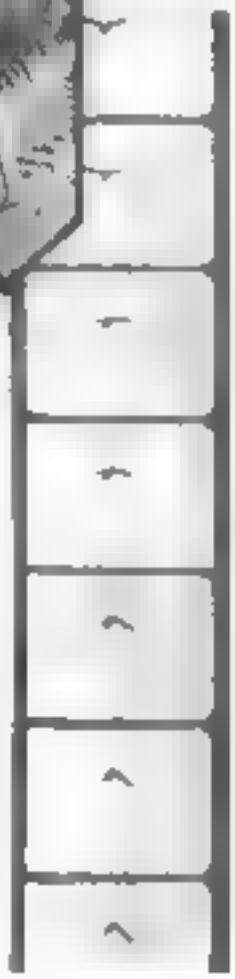


Fitting the mirror in front of the lens of the ultra rapid moving picture camera. M. George E Labrely the French cinematographer [illegible] this useful device, which opens new fields in motion-picture photography, and which can be adapted to any camera

Showing the bird in [illegible] ice with a steeple in the foreground. Two hundred and fifty pictures a second are made



Now the bird approaches the camera [illegible] and the fast film mechanism give every phase of the bird's swift motion

Sighting through the view finder and turning the mirror to follow the rabbit antics

The Wonderful New All-Metal Monoplane

As revolutionary as the first iron ship

By C. Dienstbach and L. J. Wilson

A FLASH of fire, a cloud of smoke, and down comes the wood-and-cloth airplane, a burning mass. Nothing of the kind can happen to the new all-metal monoplane, the latest innovation in aircraft. As solid as a battleship, and covered with corrugated sheets of metal, the monoplane looks too heavy to fly.

"If that airplane will fly, a battleship will fly," Colonel W. N. Hensley, Jr., said to the pilot who was about to take him for a flight in one of the huge metal monoplanes which he saw while in Germany. Imagine an all-metal monoplane having a wing-spread of one hundred and thirty feet, and weighing eight tons!

The astonishing fact is that this heavy-looking machine will not only fly, but will fly with greater economy of fuel, will fly faster and with three times the efficiency of other machines of its weight and size. What makes possible such a seeming miracle?

Dr. Hugo Junker, the maker of aircraft and all-round genius of invention, found, by a series of wind-tunnel experiments, that he could, by the utmost economy of material, make a structure strong enough to withstand great stresses and strains and yet possess the power of cleaving the air in flight. It is an adaptation of this Junker design that John L. Larsen brings to this country in the JL6 monoplane, a machine having a wing-spread of nearly fifty feet and weighing 2245 pounds.

The Fastest Machine of Its Size

The utter absence of all exposed structural features, such as wires, struts, and bracings, reduces the resistance to such an extent that the huge metal bird cuts through the air with the ease of a gigantic eagle. What flying-machine of wood and cloth will carry from six to eight passengers at an average speed of 112 miles an hour, making use of but 160 horsepower? This is only one of the many wonderful possibilities demonstrated by the JL6 all-metal monoplane.

The propeller, driven by a high-power engine used in the typical biplane, churns up an enormous wind, strong enough to bend backward one's arm held outside the protection of the wind-shield. But if one puts his arm outside the window of the JL6, he is surprised to find so slight an air-stream. The propeller drives the machine instead of driving the air

"Metal is heavy," a man thinks. To imagine tons of metal flying in the ethereal ocean overhead is not attractive to those who like the security of having nothing heavier than a cloud above them Yet, when the weight of these all-metal machines is compared with that of airplanes of wood and cloth, and when the factor of relative strength is considered, the metal machine is both lighter and safer. Not only can it withstand severe atmospheric conditions, but it suffers less damage in case of a bad landing. In the wooden craft the machine upon crashing is often splintered. Comparisons between these and the metal planes used in the war show that the factor of safety to pilot and passengers was on the side of the metal airplane. The lesson of the steel railroad-cars and the steel ship is repeated.

What Makes It Light

In the new JL6 monoplane the thick curve of the wing provides great lifting power. Therefore landing becomes possible at a speed of about forty or fifty miles an hour. The strength of the wing depends upon the simple cantilever construction of tubes and girders, which makes a tremendously strong frame within the covers of the corrugated sheets of aluminum alloy. In the thickest part of each wing near the side of the body are the gasoline-tanks, their position providing another factor of safety.

The JL6 carries from six to eight persons, including pilot and mechanic. It completed a non-stop flight from Omaha to Lancaster, Pennsylvania, a distance in the air of about twelve hundred miles, at an average speed, against a cross head-wind, of 109 miles an

Why Wasn't This Done Before?

THE world almost laughed when the all-metal airplane was proposed. We say "almost," because the spectacle of a man perishing in a machine that is one roaring mass of flame was too tragic an occurrence to cause mirth.

Now comes Dr. Junker with a new scientific study of resistance in the air. He discovers new facts. He shows that the all-metal machine is not a dream by building one, the practical results of which make it an eye-opening success.

Several weeks ago the staff of the Popular Science Monthly made a flight in this revolutionary machine. The present article is written as the result of that flight and of a critical study of the JL6 monoplane.

The tourists' Palm Beach suit and white dress remain unsoiled in this limousine of the air

hour, and consumed 105 gallons of gasoline in the trip. This flight was about four hundred miles better than the previous non-stop record in the United States.

In altitude climbing, the monoplane carried five people to a height of twenty-two thousand feet with an efficiency fully triple that of any airplane of today. In another flight it went from Atlantic City to New York with five passengers, one of whom weighed 277 pounds, and with 143 pounds of baggage, reaching an altitude of 20,600 feet, and establishing a world's record for the passengers carried and horsepower used. It was equipped with a Mercedes 160-horsepower engine and covered the entire distance in eighty minutes!

Cheaper than the Railway

The cost of air travel is totally revolutionized by the economical accomplishment of the record non-stop flight from Omaha to Lancaster. Allowing 34 cents a gallon for gasoline, the fuel consumed amounted to $35.70; the cost of the oil used was about $4.80; total cost for these, $40.50. Three people and baggage were carried. When allowance is made for the money invested, for depreciation and wear, for wages, etc., the actual transportation cost would compare with the regular railroad fare for such a trip, and pay attractive dividends on the investment. Contrasted with a similar trip in an automobile, the expenses are surprisingly light, considering how long it would take the automobilist to make the trip involving stopovers on the way. What an advantage that there are no aerial speed laws!

The material used in metal aircraft construction, "duraluminum," contains more than ninety per cent aluminum, alloyed with copper, magnesium, and manganese. Weight for weight, a tube of this metal can be made three times thicker than one of steel. This means that any slight local fracture, such as a dent in the metal, would have less effect than the same imperfection in a thin tube of steel of similar weight. In the air the wings of an airplane are subjected to enormous strain. A serious defect would cause a structural tube to give way when too great pressure is thrown upon it. Thus a decided advantage seems to be obtained in the use of thicker material, and for this "duraluminum" is better than steel, though steel will withstand a greater weight than duraluminum. Other alloys of aluminum are also used in the construction of aircraft.

Only the brainwork of a genius could have so perfected the design and made it conform to the material used

The aluminum "hawk" speeds through the air at two miles a minute. Here it is carrying passengers over the picturesque Potomac in the vicinity of Washington

in its construction, in the making of this aeronautic wonder. To make the wing design successfully meet the material, Dr. Junker had to make a correction of the established Eiffel tables, which up to this time had been used in the design of aircraft. This was accomplished by means of the wind-tunnel experiments. It resulted in the birdlike features, in which everything tapers toward the outer ends, a feature absent in other airplane designs because the novel wind-tunnel tests proved it permissible.

How It Feels to Fly

Traveling in this remarkable body of the metallic hawk affords novel sensations, even to one who has made flights in other types of aircraft. The comfort of the surroundings, the possibility of conversation, the absence of the terrific wind experienced in an open "ship," the angle at which the pilot banks on the curves, seeming to "swing" the earth, produce curious feelings in the passengers. There is such a strange mixture of the normal and the abnormal. Here you sit in the midst of usual surroundings. You look out of the window and suddenly see the great dark platter of the landscape rise up into the sky. You look out of the other window and see nothing but sky. Then the realization that you are aslant with the vertical comes over you. It is a queer feeling.

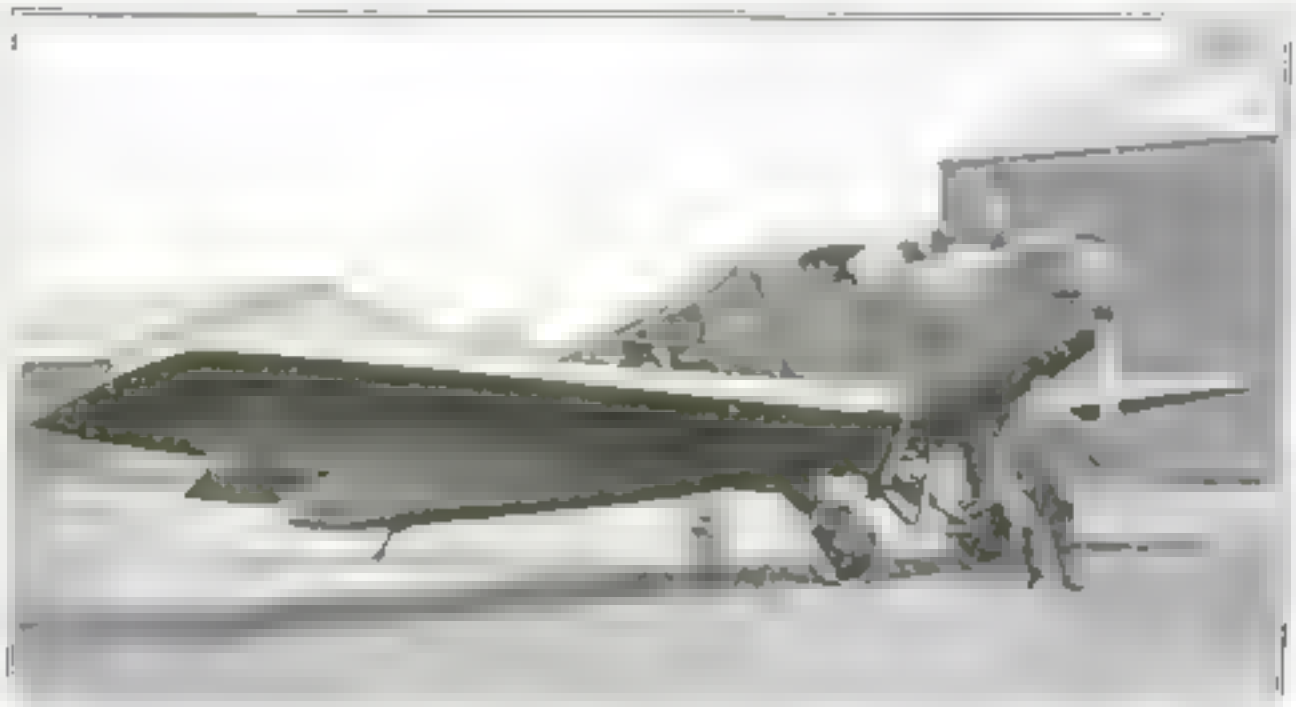
To all these actual impressions and observations there is a most significant scientific foundation. Well may the flying-machine be an apparently heavy and clumsy object if we know that the wings can carry twice as much weight a square foot as those of other airplanes. This means they are twice as strong The sturdy, thick-set owl shape can stand the storm that blows around it and will never stir except when the body and wings cleave the air in a certain way while flying. No wonder you feel an unreasonable apprehension about being supported two thousand feet high by a pedestal of metal as unlike a parachute as possible. But is it possible that such a thing supports more weight at less power—160 horsepower for six men and a supply of eight hours' fuel, and flies at the same time faster than other machines, yet lands at forty-five or fifty miles an hour?

Science Supplied a New Airplane

The answer is: the wind tunnel. It is the proved road to all real progress in aviation. Why did the Wrights fly? Because they built their own wind tunnel and discovered that all previous formulae were incorrect. Junker treated Eiffel's tables as the

Wrights treated Lilienthal's, though the latter were a marked improvement over Langley's and Maxim's. The secret of the Junker monoplane is all expressed in the words *real streamlining*. In this machine the thick-set, roomy body cleaves the air more smoothly than the overslender fuselage with its cramped quarters. The wings likewise have no useless resistance, only a sham fault, in that their high lifting power engenders an abnormal drift. But this is a small sacrifice that even pays for the advantages it affords. How?

Simply because the extremely arched, or cambered wings may be usefully driven through the air at a greater inclination than flatter wings. If high lift is required at relatively low speed—landing speed—the inclination is increased. With slightly cambered wings a point is all too soon reached where steeper inclination only increases the drift, while the lift remains unchanged. The Junker machine gains speed in spite of the drift produced by the wing-curve. The absence of wires, struts, and bracings exposed to offer resistance saves sixty per cent of the propeller's efficiency, while the wing-drift costs ten per cent leaving fifty per cent advantage over other types of wing structure. Fifty per cent of the resistance offered by the exposed wires and struts of other types of aircraft are eliminated in this remarkable monoplane.



Absence of wires and struts reduces the head resistance of the metal monoplane. With a one hundred and sixty horsepower engine it makes high speed carrying eight people

In the JL6 it is possible to turn safely while steeply ascending. In other types of machines this is dangerous because the resistance of climbing added to the resistance of struts and wires, and also the inefficiency of the wings at steep inclination, uses up the momentum and the machine soon comes almost to a stop, losing thereby control and support. The high lifting power of the wings relieves this state of affairs which is so aggravated by turning, because the centrifugal force is added to the wing load, and makes this feat possible in the wonderful monoplane.

The rule usually given student pilots by their instructors, "Never attempt a sharp turn while ascending," thus does not apply to the all-metal monoplane. With the ease of a giant bird it can make a corkscrew series of spiral turns while climbing cloudward.

Speed, safety and comfort are the principal factors considered by the traveling public. Cost of transportation is secondary where a man's time is very valuable; but aerial transportation rates will be cheaper as soon as the method of traveling becomes more popular.

Making the Prickly Pear Fit for Cattle

On some of the great farms in Texas they are now singeing the sharp, hard stickers off the prickly pears, so this peculiar variety of fruit can be fed to the cattle. The growth of this large pear with its ugly "stickers" is limited to the desert sections of the South.

The spiny growth of the prickly pear is removed wholesale by the use of a large gasoline torch. A powerful portable torch has been devised by the Department of Agriculture, and by its use the heretofore useless fruit has been made to serve a purpose. After the pears are put under this treatment, the cattle can be turned into the field, where they may eat their fill of this large, juicy member of the pear family.

Another method of treating these pears to render them harmless is by putting them through a chopper. Scientists of the Department of Agriculture who have made a study of the prickly pear, find that it is more digestible when it is chopped up.

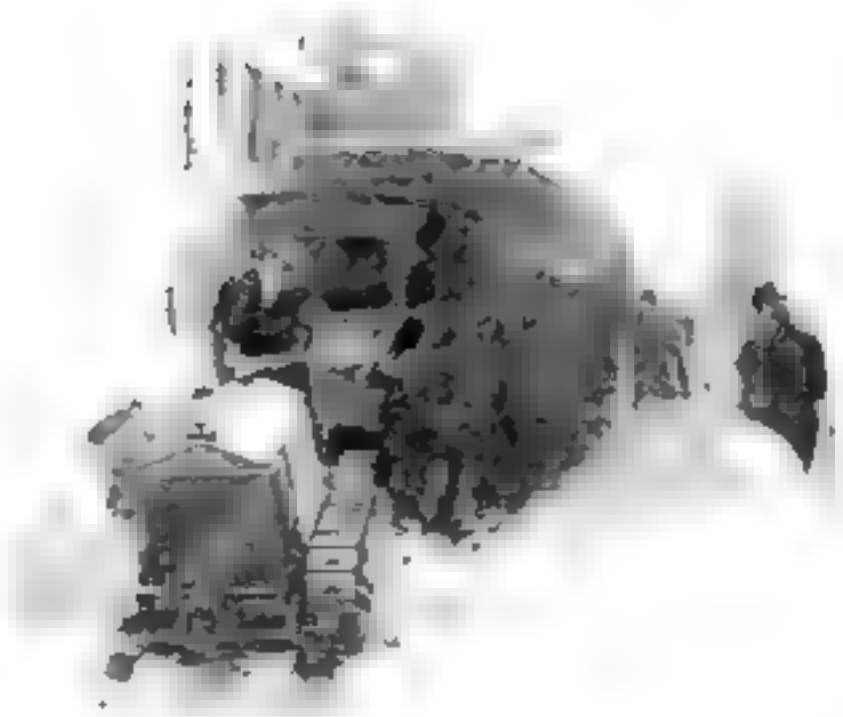
Experiments now being conducted along this line may bring the prickly pear from the status of an undesirable citizen of the desert to a law-abiding individual worthy of being developed and raised for cattle feed.

The prickly pear has been the bolshevik of the desert. They are now burning off its stickers with a gasoline torch

Prickly pears are chopped up for cattle feed. Here's a mass of them going through a cutter driven by a heavy gas-engine

Next Winter's Snow

How the Popular Science Monthly would keep city streets clear in winter and save millions of dollars



The little tractor advertised its capabilities, but it would never have a chance if New York had developed a real snow-removal plan

NEW YORK failed miserably in its attempt to cope with the mass of snow that clogged its streets in February, 1920. In fact, it has always been more or less helpless in the face of a heavy snowfall. It takes days to clear the streets after a storm. Last winter it took weeks, because New York was overwhelmed by a blizzard.

Street-car lines stopped running. Horse-drawn vehicles and motor-trucks were stalled in narrow streets, and behind them collected a long train of vehicles, waiting hour after hour until shovels slowly dug out the cork that stopped the neck of the bottle.

Clerks and factory employees had to walk to their work. There was a food shortage. Garbage and ashes accumulated in piles in the streets. Mercifully enough, there was no serious fire; for the Fire Department could not move its apparatus.

Removing Snow the Old Way

New York's Street-Cleaning Department has always followed a single plan: It uses its own forces and equipment, and supplements them by hiring trucks and such unskilled laborers as it can to shovel snow into wagons and trucks. Fifty cents an hour was the price offered to these outside laborers last winter. Fifty cents an hour! And this in the face of an unprecedented labor shortage, at a time when one dollar an hour was sniffed at by Italian ditch-diggers.

A few tramps and human derelicts appeared, and chopped and shoveled lazily. A few avenues were cleared; the city as a whole was buried in snow and ice. And these feeble attempts cost $5,500,000.

Worse than this was the business loss, which, according to the Merchants' Association, amounted to $60,000,000 in those twelve unforgettable days, when snow, sleet, and ice blocked the streets. Five million dollars a day! Such is the price of inefficiency. Ten dollars for each man, woman, and child—that is what the distribution of this $60,000,000 loss means.

A fire strikes terror. It does its work swiftly and visibly. A foot of snow in a great city is hardly less terrible. How many fires have caused a loss of $60,000,000 to cities? You can count them on your fingers. They occurred at intervals of decades. Snow falls every year in our northern cities. We expect it. Yet we never arm ourselves against it.

No one can tell whether we will have light or heavy falls this winter. But we can prepare for the worst type of snowfall that a large city north of Washington and east of the Rocky Mountains may expect. What we want is an engineering plan. We want that plan *now*, not when the snow has fallen and has been packed down into a caked mass by struggling vehicles. We want a plan that can be carried out as automatically, as quickly, as effectively, as a fire is extinguished.

How much does it cost to keep the streets open? Whatever the sum may be, it must be appropriated. It is cheaper to spend $10,000,000 to save $60,000,000 than it is to accomplish nothing by spending $5,500,000, as New York did last winter for lack of an engineering plan. Money plus a plan will solve this problem; money without a plan will do nothing.

Popular Science Monthly Offers a New Plan

The Popular Science Monthly offers a plan. It is simple. It will prove effective in keeping the streets clean in any city. It is a plan that considers snow removal as vital as fire-fighting. It involves the expenditure of more money than has ever been spent in the past for removing snow. But it is cheaper than any plan that has ever been tried, because anything is cheap that will avoid a loss of $60,000,000, and enable a city to feed

Show This Article to Your Mayor and Your Board of Trade

This is the fourth of the Popular Science Monthly's series of articles on business uses of the motor-truck. We have made it one of the series because streets must be kept open in winter if motor-trucks are to be run, and the motor-truck can help to keep the streets open.

New York was paralyzed for twelve days last winter because it had not adequately prepared for snowfalls. It lost $60,000,000—about $10 an inhabitant—because it had no plan. Maybe your city was paralyzed too. If it was, what are city officials doing about next winter's snow?

Read this article on the Popular Science Monthly's plan for keeping the streets open. If you believe in it, as you must when you think of last winter, then show it to your Mayor, or your Street-Cleaning Commissioner or your Board of Trade—perhaps to all. Remember, you pay the bill when the streets are clogged with snow.

The Popular Science Monthly will cooperate with any municipality that wants to carry out the plan here outlined, by giving all the technical information in its possession.

Some advocate the snow-plow that is dragged behind a motor-vehicle. Such plows were used by auto buses in New York when the buses could run

New York has purchased three hundred and fifty pusher-plows for next winter, to be used with motor-trucks, but plows without a workable plan will not help much

itself and to keep its street-cars and its vehicles moving

The essence of the Popular Science Monthly's plan consists in removing the snow almost as fast as it falls. No time must be given for accumulations to be packed down.

Use Plows with Motor-Trucks

First of all, the city is to be divided into zones, and the zones subdivided into sections. Every section in a zone is to be cleared by a motor-truck equipped with a plow. All the 3½- to 5-ton trucks of the city are to be mobilized at once, when the emergency arises, just as fire-engines rush to a fire. True, plows do not remove snow. On the other hand, they do keep the streets clear; the snow pushed aside can be removed later. Keep the streets open—that is the first principle of the Popular Science Monthly's plan.

The idea of employing motor-trucks in subdivided zones is not new. It has been tried, and it has failed because human nature was not considered. About thirty dollars a day has been paid in the past for the use of a five-ton motor-truck in snow removal. Too little—much too little. What happened? When the truck-owner received an offer of fifty dollars a day from some merchant bent on making the attempt to ship his goods despite the prevailing conditions, he ceased then and there to remove snow, even though he violated a contract with the city.

Clearly, the price to be paid for the truck must be so high that there is every inducement to keep it at work plowing snow.

But that is not enough. The motor-truck must begin to plow as soon as the call comes—at two or three o'clock in the morning, if necessary. What of the driver? Will he respond cheerfully when aroused in the dead of the night? Not if we know human nature. *It must be made worth his while to get up as promptly as a fireman when the bell in the engine-house clangs.* He, too, must be paid by the city—paid over and above what his employer pays him in wages. It may be that the driver will earn three, four, even five dollars an hour while he is plowing snow. But the Popular Science Monthly's plan takes account of human nature—something that has always been ignored in facing this problem of snow. Besides, it is cheaper to remove the snow at a high cost than to peck at it and not remove it at all.

When Jones, driver of the A. B. C Express Company's truck No. 25, is awakened at night and instructed to proceed to Section 10 in Zone 2 and plow snow, he will go cheerfully to his task, because he knows that he will make several times as much money an hour as he ever made before in his life.

When the emergency call comes, Jones goes to the nearest station of the Street-Cleaning Department, gets one of the standardized snow-plows, attaches it to his truck, and proceeds to his district, there to place himself under the orders of a foreman of the Street-Cleaning Department and to remain under those orders until he is released.

Unless Jones is paid by the city, and well paid, in addition to the wage that he receives from his regular employer, the truck-owner, neither this nor any similar plan will succeed. Human nature must be considered—the psychology of the truck-driver and of the truck-owner. We are dealing with an emergency. Emergency tasks must be paid for at emergency prices. Otherwise those who perform them will not look upon them as emergency tasks.

The Need of Cooperation

Contractors, express companies, railways, merchants, every firm that owns a motor-truck, must cooperate in clearing away the snow. But suppose that, even at the high price paid for the use of a truck, its owner insists on using it in his business? If, in spite of adequate payment, according to the Popular Science Monthly's plan, the truck-owner still refuses to cooperate—what then? The police must step in.

The man who attempts to haul goods after a certain depth of snow lies in the streets, before the plows have had an opportunity of completing their work—that man must be summarily stopped. If necessary, he must be punished by the revocation of

What could pick and shovel do in the face of tons of snow? Only efficient machinery could deal with the problem

his license. He must not be allowed to pack down the snow. If he is not allowed to operate his truck in his own business, he will cheerfully use it to earn money in clearing the streets.

For a few hours, at the most, will it be necessary for the police to interfere. Some streets will be designated as one-way streets, so that vehicles may travel down the path plowed in the middle. Not until the plowed snow is removed will two-way traffic be resumed. Last winter no wheel moved in either direction. New York was stagnant for twelve whole days.

Time Is the Essence of the Problem

Plowing the streets, then—that is the first step. Next comes the actual physical removal of the snow. In the past, New York has tried ineffectually to keep its streets open by removing the snow in the very first instance. Thereby it complicated its problem enormously. To shovel snow into wagons and remove it bodily by the thousands of tons is of necessity a time-consuming task. And time is the very essence of this problem. No large city can afford to lose days. And, we repeat, New York *lost twelve whole days* last winter.

The Popular Science Monthly's Plan for Snow Removal

1. Make snow-plowing an emergency task, like putting out a fire.
2. Mobilize all the 3½- to 5-ton motor-trucks in the city under the orders of the Street-Cleaning Department. Equip each truck with a standardized and municipally owned snow-plow, and assign the trucks to plowing in a definite section of the city. This must be done *now*—not after the snow has fallen.
3. Store city-owned snow-plows, which can be attached to motor-trucks, in convenient stations throughout the city. Let the truck-drivers proceed to these stations for plows when they receive the emergency call.
4. Pay the truck-owner *more than he can receive for hauling*, so that he will not be tempted to violate his contract with the city.
5. Send each truck out to plow snow as soon as the emergency arises, even though it be in the dead of night. Pay not only the truck-owner a high rate for the use of his truck, but also the truck-driver, *in addition to his regular wages*, so that when the call comes the driver will respond cheerfully.
6. Empower the police to stop all traffic until the streets are plowed. After the streets are plowed make some of them one-way streets.
7. When the storm is over and the streets are plowed, remove the snow by excavating and dirt-handling machinery.
8. Inspect the trucks and the snow-removal equipment before and after they have done their work, so as to avoid unjust claims for damages.

The Popular Science Monthly's plan provides for snow removal by machinery, where machinery can be effectively used. New York did make the attempt to use excavating machinery, tractors, and army "tanks"; but it placed its chief reliance on picks and shovels.

It so happens that the excavating and dirt-handling apparatus of contractors is usually idle in the winter months. To make arrangements for its use in removing snow from plowed streets ought to be no difficult matter for the municipality. Snow should be handled by the cubic yard, and not by the shovel.

The City's Part Requires No Heavy Investment

The Popular Science Monthly's plan involves no heavy investment on the part of the city for snow-handling equipment. It must buy several hundred snow-plows that can be attached to motor-trucks; it must store these snow-plows at designated stations; it must inspect the motor-trucks that do the plowing before and after they have performed their duties, so as to avoid unjust claims for damages. And that is all, so far as equipment is concerned.

Consider the beneficent results that will be enjoyed by any large city that has a really workable plan for snow-removal when the next great blizzard comes. If handled efficiently, the delay should be so slight as to be almost imperceptible.

New York and other large cities failed miserably in attempting to cope with the snowfall of February, 1920. People had to walk to work. There was a food shortage. New York alone lost $60,000,000, because it used antiquated methods

New York to Have the World's Biggest Radio Station

The six antennae can be operated as one unit

By John Stuart

REMEMBER how it was in the early days of electric traction, electric light, and power service, or telephony? There were small companies with isolated stations, each pursuing an independent policy in engineering development and business expansion. Now we have large units supplying huge territories; and business men have learned to rely absolutely on the continuity of the desired service.

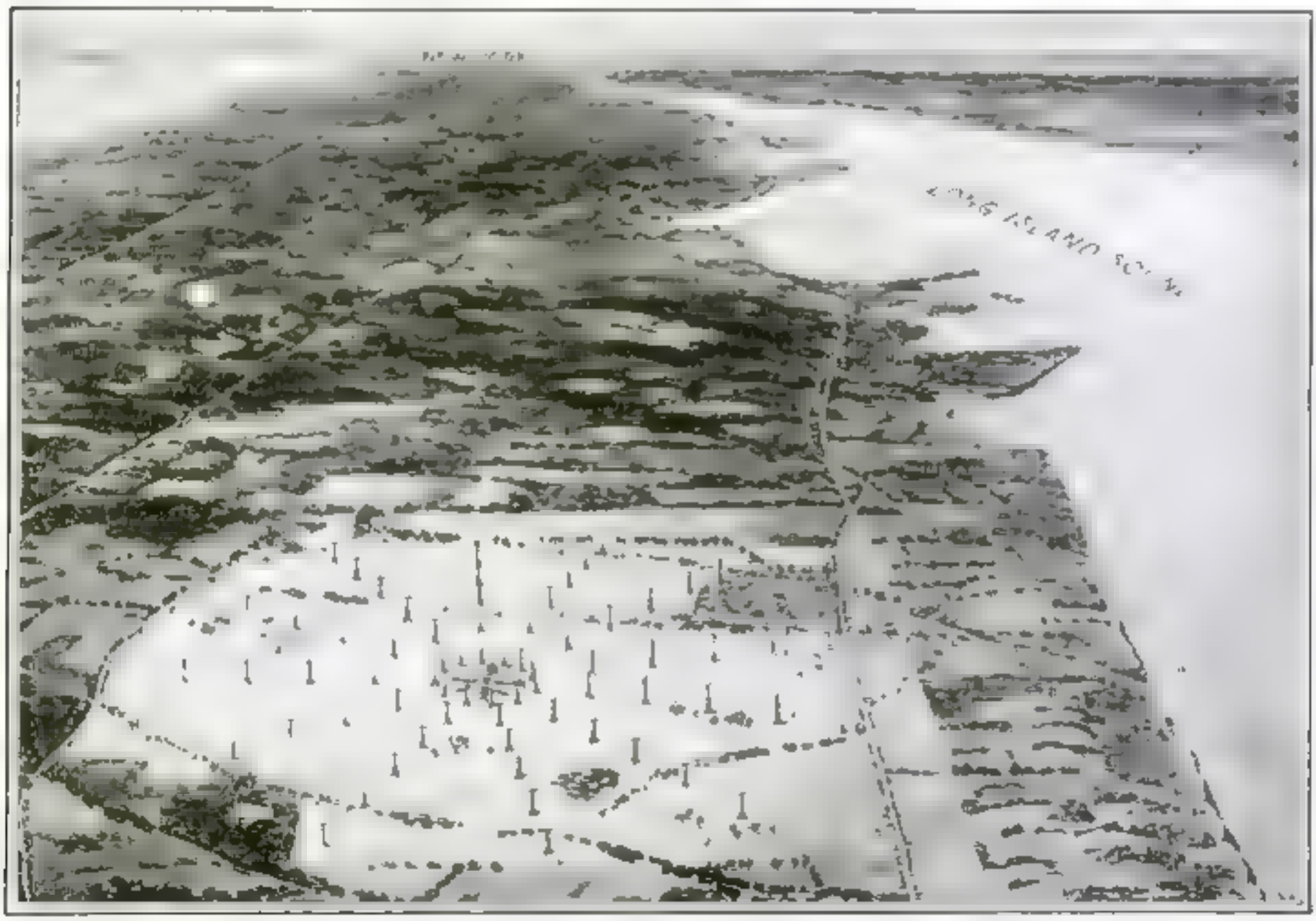
Radiotelegraphy and radiotelephony have also passed through the stages of experimental development. The huge station shown in the picture on this page will help American business men to form the habit of radio communication. In it the best apparatus design of the engineers of the General Electric Company is combined with the operating experience of the Marconi Company. The building contracts are now being let and construction will soon be under way. Ten square miles, sixty-four hundred acres, will be needed for the antenna systems and buildings. Six long lines of steel towers meet at a single point where the transmitting apparatus is located. Each line carries the antenna of a high-powered system. Five of these will operate with France, Germany, Poland, Sweden, and other European countries, and with important cities like Buenos Aires in South America. The sixth is for insurance of service.

The wires of each antenna will be suspended from cross-arms 150 feet long, which are supported by steel towers each 400 feet high. The power for each antenna will come from two special generators, designed by Alexanderson of the General Electric Company. Each has a capacity of 200 kilowatts.

When occasion requires, all six of the antennæ may be connected, forming a station with a capacity of 2000 kilowatts. On the other hand, each of the antenna systems may be operated as two, giving twelve spokes to the radio wheel and permitting twelve simultaneous messages.

For the high-speed transmission of telegraphic signals there is the Hoxie receiver, which makes a photographic record of signals too fast to be distinguished by the human ear. Messages are sent by a mechanically operated switch instead of by a key, the speed of which is limited by that of an operator's hand. At the receiving station they are detected by a vacuum-tube detector and then caused to actuate a small light mirror. The motion of this mirror flicks a beam of light back and forth across a moving tape of photographically sensitive paper. Operators then read this tape, writing out the message or re-transmitting it over land telegraph lines.

This station, which is located sixty miles from New York, at Port Jefferson, Long Island, will only transmit. The return messages will be received at another station about eighteen miles away. Both the receiving and transmitting stations will be connected by land lines to the office of the Radio Corporation on Broad street in New York city and operated from it.



The world's biggest radio station, at Port Jefferson, Long Island. Ten square miles will be needed for the antenna systems and buildings. It will be a transmitting station only, a receiving station being built elsewhere

Elevating devices and movable chutes handle the unloading of a ship in half the usual time

Saving Time in Unloading Ships

THE first large steamship, the *Great Eastern*, was a financial loss partly because it took too much time to load and unload her cargo. It costs $3000 a day to hold a modern transatlantic steamer at her pier.

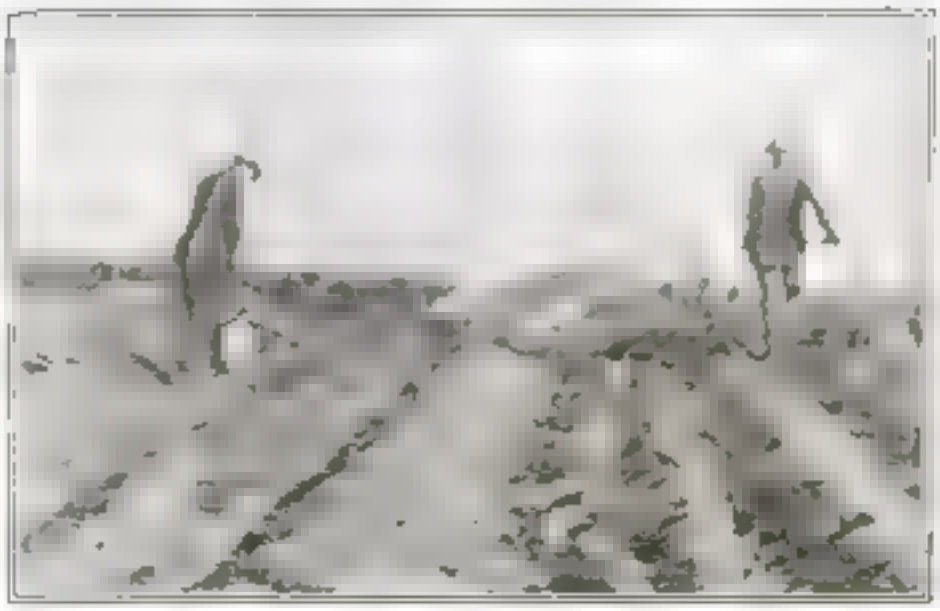
An invention of Gibson L. Douglass, of Duluth, Minnesota, promises to revolutionize the unloading of vessels at their docks. It consists of a number of elevating devices and telescoping movable chutes installed in the ship, by means of which material such as sacks of cement, flour, and packages of various kinds may be quickly handled. A day's work in unloading by hand can be accomplished in a few hours by the new system.

Elevators near the ship's center are connected with telescopic conveyor spouts. The material to be unloaded is sent through the chutes by gravity, keeping the stevedores steadily employed, delivering the packages directly into the conveyor tubes. The "telescope" feature adjusts the tubes to the height of each deck.

Liquid Fire for Exterminating the Corn-Borer

GET the oil-tank ready and prepare to spray the stubble in the field with liquid fire! Burning is the surest way to get rid of this obstinate and disastrous pest of the cornfield, the corn-borer.

The European corn-borer has made its appearance in certain sections of this country, probably being imported in cargoes of raw hemp which came here from abroad. There are two generations a year of this dangerous pest, and the cornfield infested is a center from which it spreads. The Department of Agriculture has undertaken the task of helping the farmer to get rid of the insect which takes the profits from his labor.



Spraying a stubble field with liquid fire to destroy the corn-borers. The insects infests the weeds as well as the cornfield

The corn-borer works under the cover of the cornstalk, and is not accessible to blackbirds, flies, and other natural enemies.

Plowing the infested stubble and burning it, or spraying fire in the stubble-field, is the most effective way to destroy the larvae of the insect. As many as a million borers may infest one acre of corn.

Why Oil Is Driving Coal from Ships

The *Olympic* will save $1,300,000 a year

By Latimer J. Wilson

OIL is taking the place of coal on the high seas. Sweating, half-naked stokers have disappeared from the leviathans of the ocean, and instead only a few furnace-tenders are seen in the boiler-room.

But that is not the reason oil was adopted. It gives more power and reduces boiler repairs by getting rid of clinkers, which injured the lining, and it also takes up less space. There is no loss of fuel in "dead" hours, because the fires can be lighted instantly and brought to the right temperature in forty seconds. Fires can be shut off at once in case of emergency. Since the furnace doors do not have to be opened for continual firing, there is a more equal distribution of heat. There is also less accumulation of soot on the boiler-tubes. King Oil has deposed King Coal in the boiler-room because in every way he serves the requirements far better than does coal.

Eighteen years ago the first oil-burning steamship, the *Arab*, made a voyage across the ocean. To-day about two thousand vessels have been equipped to burn oil, and it will not be long before every steamship will have ceased to burn coal in its present cumbersome form. The *Olympic*, recently equipped as an oil-burner, furnishes excellent proof of the extraordinary advantages achieved in this respect. Figures show that the annual saving will reach $1,300,000, and this entirely disregards the lower cost of oil compared with the present price of coal.

How Oil Compares with Coal

The first overseas trip as an oil-burner shows that the steamship maintained an average speed of 21.5 knots an hour, as compared with 20.5 with coal. At this rate, twenty-one trips a year will be possible instead of the usual twenty. Two main engines of 26,000 horsepower, and an additional directly connected turbine engine of 17,000 horsepower, drive the *Olympic* on her course. In the fire-room are 159 furnaces with five single-end and twenty-four double-end boilers. An electrical indicator in the boiler-room shows the number of fires required at any time. Tank space for 5200 tons of oil is provided.

To put coal into the *Olympic*'s bunkers took 140 men working from three to four days. Seven men accomplish the equivalent of this task in six hours, piping oil into the tanks. Coal produced such an amount of dirt that a whole day was spent cleaning up the ship, while complete repainting was necessary after every alternate trip. Just consider what this and other savings amount to from the viewpoint of finances! Allowing 3½ days and 133 men each voyage, at $3 a day, the amount saved on bunkering alone is $29,327 a year, counting 21 trips instead of 20. Oil releases 1000 tons of cargo space each trip, estimated at $525,000. Owing to the release of 153 extra firemen, more passenger space is provided, giving a further saving of $491,400. The wages saved by the release of the 153 firemen amounts to $165,240, while the cost of their subsistence, $82,620, is an additional saving. The total annual saving thus amounts to $1,293,587.

Burning the Oil in Air

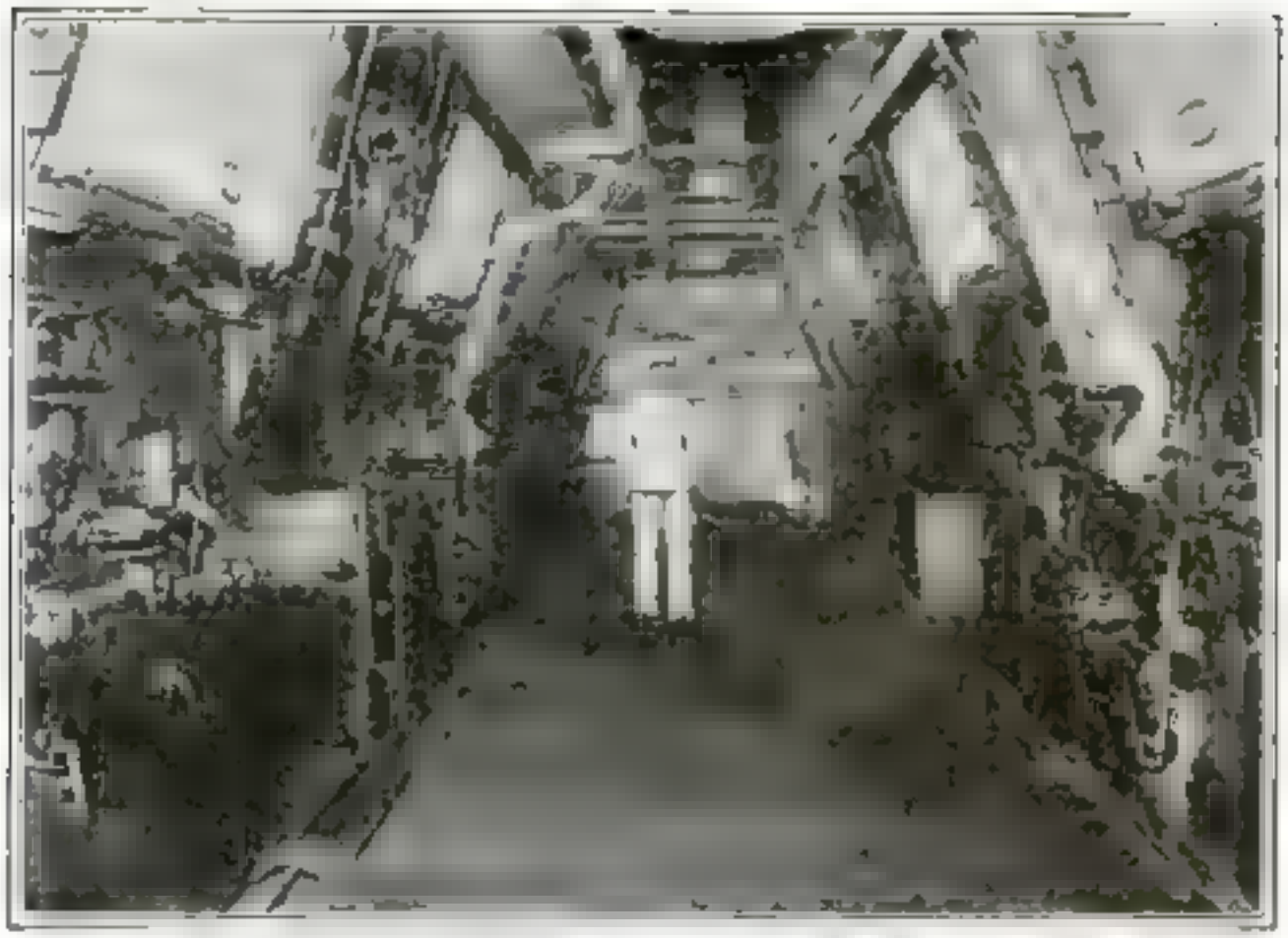
To obtain the full heating value of any fuel there must be complete combustion, which, expressed broadly in chemical terms, means that every atom of carbon in the fuel must combine with two atoms of oxygen. Every atom of carbon that escapes up the smokestack, combined with only one atom of oxygen, carries away a part of the heat-producing quality of the fuel.

When any fuel is burned it is necessary to admit enough oxygen to permit the free combination of the carbon and oxygen-forming carbon-dioxide, the product of combustion. The air readily gives up its oxygen to the carbon. This is illustrated by a piece of paper lighted in the open, which burns completely. But if it is enclosed in an airtight compartment, such as a glass tumbler having a tight cover, it will burn only a moment—just long enough to exhaust the oxygen in the imprisoned air. To obtain the best results from oil as a fuel, it is necessary to regulate the air admitted to the furnace.

The Latest Oil-Burner

The oil-burning installation on the *Olympic* is obsolete compared with the very latest type of oil-burner being installed in steamships and industrial plants which differs from the old by permitting an accurate adjustment of air admitted to the flame. The oil is pumped into the storage-tanks, and, before passing to the burners, it is mechanically strained to remove particles of grit and sand, which are held in suspension in the crude oil from the wells. This foreign material is caught and collected in the strainer baskets, which are cleaned out about every twenty-four hours. The strained oil is heated to temperatures from 150° to 300° Fahrenheit, according to its character. With a compression pump the heated oil is sent under a pressure of about eighty pounds to the square inch through another strainer. This

The boiler-room of a coal-burning steamship. Note the dirty quarters and imagine the heat and grime accompanying the furnaces and coal-shoveling



This is the same room with the boilers equipped for oil-burning. The most immaculate of summer uniforms can pass through unscathed

eliminates the possibility of any foreign material reaching the atomizing device to which it passes to be sprayed in the form of a cone.

The burner and air-regulator, the latter a strictly new feature developed by William H. Todd, are installed in the furnace door, as shown in the illustration.

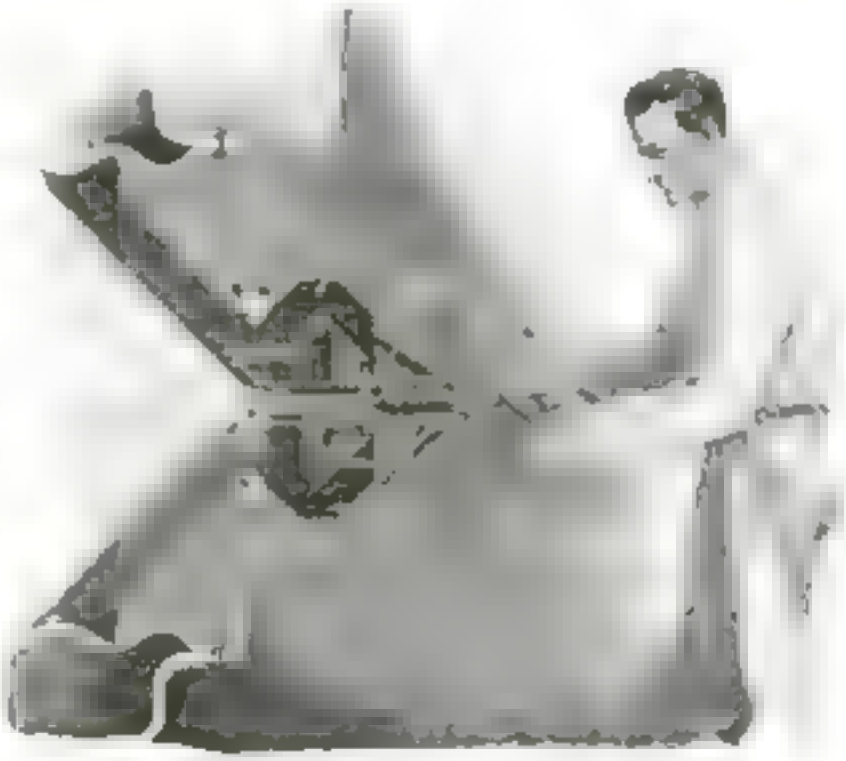
All Oils Not Alike

The oil is heated to reduce its viscosity or body, so that it will flow rapidly to the burner passages and be easily atomized when it issues from the small hole at the tip of the spray

Crude oil varies greatly with the locality from which it is obtained. Even the run of oil from the same well varies in quality. Some oils are heavier than others, some more viscous. Some have to be heated considerably before reaching the proper state of fluidity, while others at normal temperature are almost ready for the atomizing device in this respect. When oil is heated it gives off vapors, which finally permeate the air to such an extent that the mixture of air and oil vapor becomes an explosive mixture, combustion taking place instantly. This point is called the "flash" point of a grade of oil and it differs in degree of temperature in various grades of the oil, some having a higher flash point than others.

The oil sprayed into the furnace under the boilers burns continuously at a degree exceeding that of the flash point This degree of temperature is defined as the "firing-point" of the oil, and it indicates a heated vapor that will burn continuously when ignited in air. Oils having a flash point of 150° F. and over, can be stored safely. The firing-point of oil is about fifty degrees higher than that of the flash point.

When the fine spray of vapor is projected under pressure into the furnace, one can readily see how important it is that the vapor should be thoroughly mixed with the air to assure perfect continuous combustion. The air is heated to prevent the chilling of the flame. Both the oil and air, before being admitted to the furnace, are raised to the proper temperature with steam from the boilers. While too little air mixed with the atomized oil produces incomplete combustion, if too much air is admitted the heat of the flame will be partially wasted in the heating of the surplus air. Thus with both the fuel and the air raised to the proper degree of temperature, and with an exact regulation of the amount of air, perfect combustion occurs. One sample of oil at a constant pressure may require little heating to produce efficient results, while another may have to be raised to a relative high degree of temperature to assure efficiency.



The oil-burner installed in the furnace door A cone of flame is sprayed under the boiler, the amount of air being regulated

Cost of Operation Is Less

Financially considered, the total saving in operating costs using oil as fuel varies from thirty to seventy per cent, depending upon the type of ship or power plant. Each installation has its particular problems which can be efficiently met, sometimes only by experience.

Oil does away with the handling of ashes. It banishes the nuisance of smoky cities, and produces less soot to clog the smokestacks. Estimates based upon plants operating with oil for fuel instead of coal give such results as these: a twenty-five per cent reduction in expense of firemen; a sixty-five per cent reduction in fuel consumption; ash-handlers, coal-passers, etc., reduced to nothing; a ten per cent reduction in bunkering time; and a sixty-five per cent increase in storage space. This alone is a good argument in favor of using oil instead of coal for the fuel of industrial plants, private furnaces, ships, and even railroads.

The Cunard liner *Aquitania* furnishes still another instance of the value of oil as fuel instead of coal. She left New York for Cherbourg on July thirty-first, equipped the same as the *Olympic*, with the mechanical oil-burner invented by William Albert White.

The last 129 miles of the *Aquitania's* voyage was made at the record rate of 27.40 knots an hour, truly a good rate of speed for an ocean-going steamship.

In the near future it is likely that this record will be surpassed, and even more time will be saved.

The instances of these two great ships converted from coal- to oil-burners demonstrate that the principle of using oil instead of coal affords the efficiency which makes for greater speed, not to mention the greater cleanliness and economy

Look to the future for the development of the oil-fuel age! Only the exhaustion of our natural resources will stop the great advance.

A Controller on Deck Directs This Ship Like a Trolley-Car

THE latest invention in marine engineering, the yacht *Elfay*, comes into port with the navigating officer manipulating a control handle similar to that used by a trolley-car motorman.

If the officer wants the engine to stop, he merely turns the handle of his controller to the "off" position. To go forward, the handle is swung around to the left. A number of notches give increased speeds. To "back up," the handle is moved around to the right. Before the officer's eyes is a panel with a number of instruments that give full information as to the operating condition of the machinery.

Thus the boat is absolutely under the navigator's control. A word to the quartermaster at the wheel changes the course; a touch on the controller changes the speed or the boat's direction. And the "liveliness" of this control can be judged from the fact that the propeller can be changed from full speed ahead to full speed astern within a short five seconds.

Of course, electricity is the only power that can be controlled so conveniently. But the *Elfay* is more than an electrically propelled boat—she is the first craft in the world to use the system of propulsion known as the oil-electric. There are other electrically propelled boats, which obtain their power from storage batteries, steam turbines, or gasoline-engine-driven generators; but the *Elfay* is unique in that her main engine is of the Diesel type.

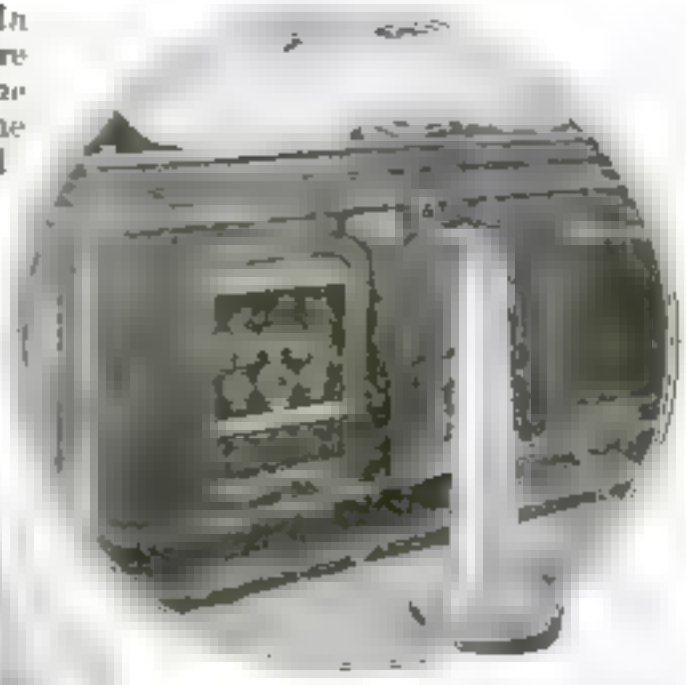
The *Elfay*'s main engine is a Winton full Diesel oil engine of one hundred and fifteen horsepower, which operates a seventy-five-kilowatt direct-current generator. This generator provides current for a ninety-horsepower motor directly connected with the propeller.

The engine and generator are started in the engine-room. The engineer's duty is merely to keep them running continuously at constant speed. The control of the propeller motor is centered in the controller on the deck, so that the engineer has nothing whatever to do with the actual operation of the vessel.

There is a nine-kilowatt exciter, which excites the fields of the main generator and the main motor. In the main generator field circuit there is a field rheostat controlled by the control handle on deck. Moving the handle to the off position, the field circuit is broken between the exciter and generator. The generator has no field, and consequently does not deliver current to the motor, and the propeller does not turn.

Moving the control in a forward direction first connects the generator field with the exciter, and then gradually decreases the resistance in series, thus permitting the generator field to increase gradually. With every increase in the strength of field, current of greater voltage is supplied the motor, thus increasing its speed.

Many engineers believe this drive to be the most nearly ideal for merchant vessels of small and moderate capacity because of the high fuel economy of the oil engine, the reliability and flexibility and ease of control of the electric power, and the great safety obtained through the use of several small engines and generators, so that one or more can be out of commission without crippling the ship.



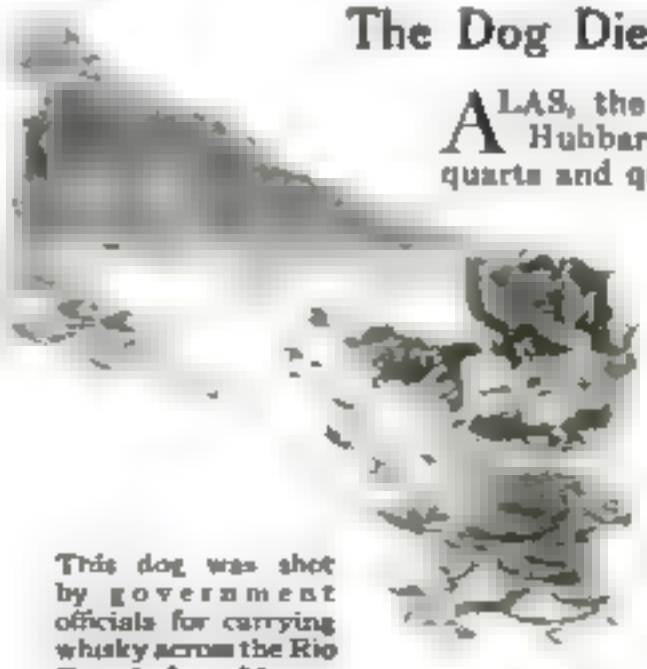
This is the yacht *Elfay*'s control handle that turns the current on and off. Several speeds are obtainable

The yacht *Elfay*, the controls of which are similar to a trolley-car is equipped with an oil engine and an electric generator and motor

The Dog Died Fighting Prohibition

ALAS, the poor doggie is dead—not Mother Hubbard's dog, but the dog that smuggled quarts and quarts of whisky from Mexico to this land of the free. Every night he swam the Rio Grande at least a dozen times, carrying on his back, each trip, four full quart bottles of whisky. He changed his route each night, and thus for a long time he was able to evade the law. Finally, however, he was detected and shot.

If that dog had lived for ten years and had carried on his nefarious work, there would have been nearly two hundred thousand extra quarts of whisky in this country!



This dog was shot by government officials for carrying whisky across the Rio Grande from Mexico

He Carries His X-Ray with Him

FOR many years the X-ray has been the invaluable ally of surgery and medicine, but until recently it has been necessary always to transport the patient to the laboratory. Now, however, there is a portable X-ray outfit.

It is possible for a doctor to transport the entire apparatus, packed in four bundles, to any house wired for electricity, and produce radiographic results as good as those secured in a completely equipped X-ray laboratory. The process of operating the machine is simplified by control systems enabling him to use the exact ray intensity he needs. A time switch accurately controls the length of each exposure. With these adjusted, the doctor merely presses a button and the machine does the rest. An ordinary incandescent-light circuit will supply all the necessary current.

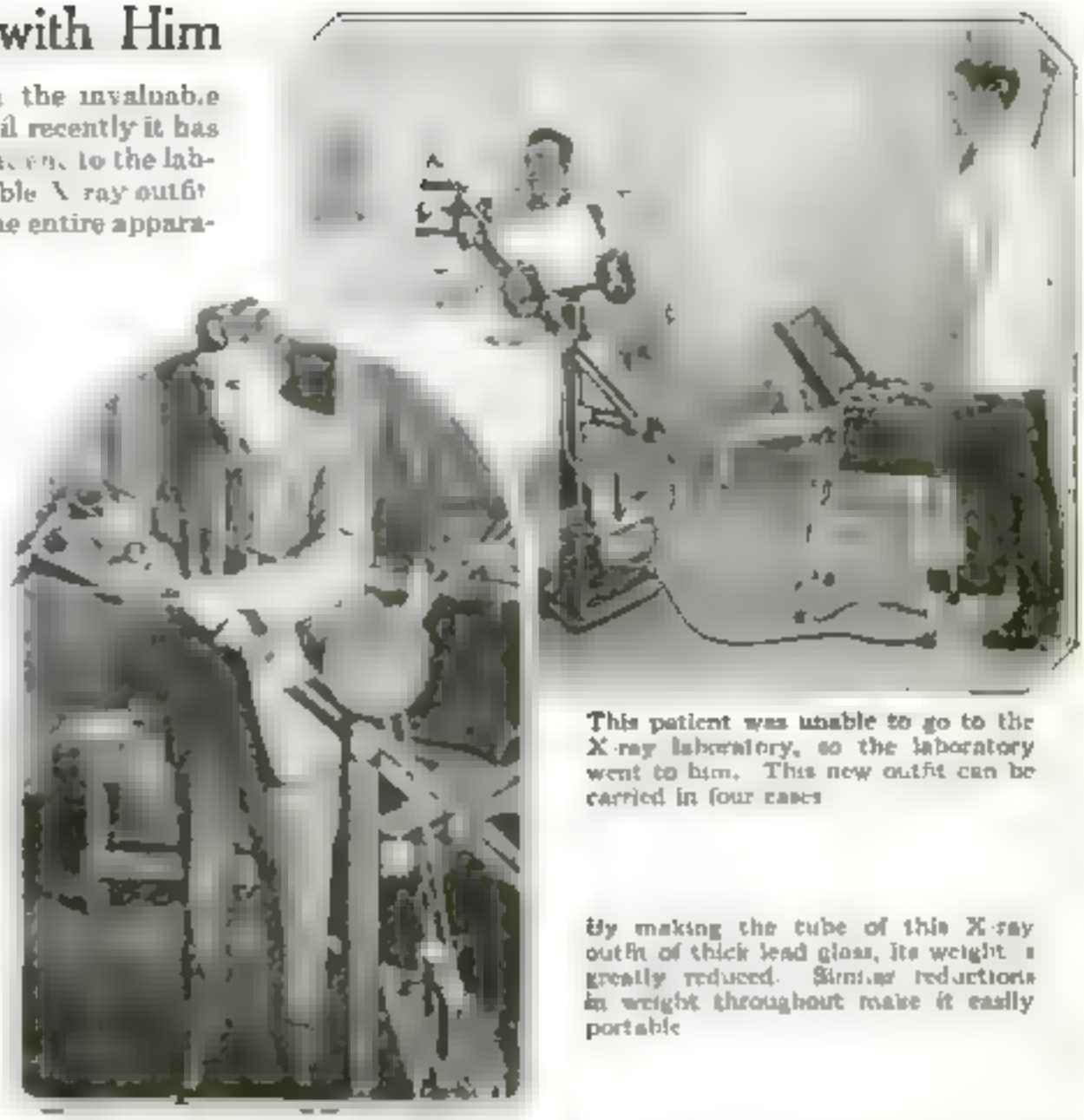
The device is meant also for hospital use so that it can be taken to the bedside of patients who cannot be conveniently moved. The results produced with this outfit are comparable with those of any ordinary X-ray machine, except that its power is too low for instantaneous gastro-intestinal radiography.

The portable set has been consolidated and simplified over the army type familiar to medical corps men. The bulb itself has been reduced in size to two and one half inches. By making the tube of thick lead glass, the total weight of the tube and its protection has been reduced five pounds, with a consequent lightening of the frame that supports it. This lead glass contains about fifty-seven per cent metallic lead, and in its resistance to X-rays is equal in protective power to lead one sixteenth of an inch thick.

The new tube rectifies its own current, thus doing away with a heavy, bulky rectifier and adding to the efficiency of the set as a whole. The transformer has been reduced in size by the use of smaller windings and a case shaped to fit the coils. Minimum weight and bulk is secured in all other parts of the outfit by a careful choice of materials and a study of sizes and shapes. Thus, when the device is ready to be taken out for use, it can be put easily into the tonneau of a small automobile and as easily carried in or out of a house.

One of the obstacles to radiography in houses is the variation in circuits between city and city or even between different parts of the same city. This is overcome by the control system of the portable outfit by means of which it is possible always to deliver the same definite voltage to the transformer primary.

Thus under all ordinary conditions the new portable apparatus can be used almost anywhere with ease and accuracy.



This patient was unable to go to the X-ray laboratory, so the laboratory went to him. This new outfit can be carried in four cases

By making the tube of this X-ray outfit of thick lead glass, its weight is greatly reduced. Similar reductions in weight throughout make it easily portable

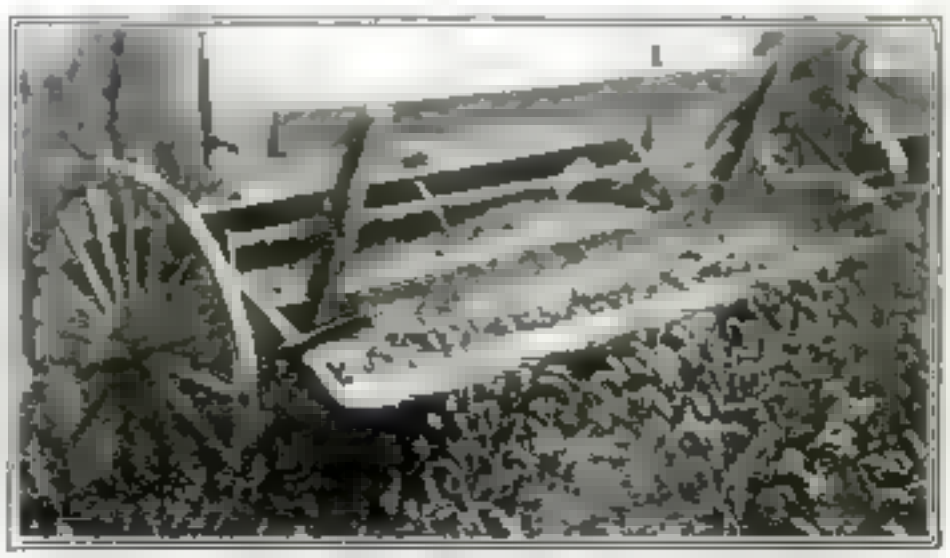
A Machine that Harvests Crimson-Clover Seed

THE heads are chopped off crimson clover and the seeds subsequently removed for future sowing. Heretofore a mowing-machine has done the beheading, but the Department of Agriculture has recently developed a new machine that does the job more efficiently.

It is a rotary harvester, equipped with long narrow guide teeth that travel close to the ground, gathering clover large and small. There are wide, rounded spaces between the teeth, thus preventing clogging. The teeth plow through a field of clover, pulling off just the heads.

Clover ought to be stripped when about three quarters of the seeds are ripe. Loss of seed is then negligible. But the machine must do some hard pulling in order to get the heads off. The teeth should be set close to the ground.

If the clover is dry, the hulls strip readily and the teeth may be raised. A lever at the side of the machine is used for raising and lowering them. Ten acres of clover seed can be stripped in a day when one man and a team of horses operate the machine.



Long, narrow teeth projecting from this machine chop the heads off clover with practically no loss of seeds

Do It with Tools and Machines

New things that aid the shop manager to speed up production

At last an instrument that will remove a rusted screw. A few pounds' pressure at the end of the upper bar and on the ratchet handle will suffice to remove the screw

A few quick turns [illegible] No misplaced keys, for the thumb and forefinger are the only tools required

A tool for stripping insulation from wire ends. Knives [illegible] The wire is fed into the opening

The construction [illegible] but a pair of [illegible] operate of an [illegible]

[illegible] mesh is carried for this screening machine. The [illegible]

[illegible]

Cutting through a thirty-five-inch carbon steel ingot [illegible] rotary saw blade. As the inserted teeth are worn, they are removed and sharpened, or new teeth are inserted

A new tool for electrical workers is this full crown [illegible] The head is of insulating material and is safe for workmen to use

A new worm-drive portable drill embodies powerful gear [illegible] Each section of the drill is a unit

Eliminating Some of the Hardships of Housework

Dust your washes instead of drying them — it's easier. The new drainer above has racks for plates and special compartments for cups and glasses. A drip pan catches the water you pour over the racks.

When using an electric vacuum cleaner you often forget the cord, but a jack reminds you of the switch. A drag weight forms a connecting link between the two.

When you're traveling, a hair brush isn't much good if you haven't a mirror. The two are here combined so that when closed, face to face, they look like a soap container and can be easily carried.

Years ago dirty clothes were [illegible] a bag; but they have evolved a clothes hamper in recent years. Wicker [illegible] are perhaps at proper seasonal [illegible]. And so [illegible] wonderful [illegible] of ventilation is provided for.

Use the heat radiating from the gas heater to dry fruits, etc., by [illegible] a rack at the back of the stove.

Wrapping a cloth moistened with water on a Gas [illegible] and [illegible] a chest [illegible] will [illegible] the [illegible] cool. By keeping on the water he kept the air chest cool.

No ice? Fill a soup plate with water, place your butter in it, and cover with a flower pot. The pot absorbs the water and keeps the interior cool.

There is a mechanical back-scrubber. You adjust the brush, fasten it to the rod, and move the handle up and down.

If you can't see well enough to thread a needle, the spool-holder above will help you out. A small magnifying-glass is attached to it. Hold the needle at back of glass.

All Winners—of Our

Popular Science Monthly is

Nicholas Bauer
Adrian, Minn. Age 16

Ruby Painter
Alhambra, Cal. Age 17

H. J. MacMillan
Syracuse, N. Y. Age 17

IN January, 1919, the POPULAR SCIENCE MONTHLY made a $5000 scholarship offer, to be competed for by high-school and preparatory-school students.

The contest committee divided the United States into ten groups, the best student in each group to receive a $500 scholarship, the prize-winners to be selected by JOHN F. WOODHULL, Professor of Physics at Teachers College, Columbia University; Professor ALFRED E. BURTON, Dean of the Massachusetts Institute of Technology; and Dr. C. R. MANN, Chairman of the Advisory Educational Committee, United States Army.

On June 2, 1920, the examination, which was based on the May, 1920, POPULAR SCIENCE MONTHLY, was taken in their own schools by more than five thousand students, of whom the following ten, representing the best in each group, received scholarships

Mid-Atlantic Group
EVERETT CARMAN, Central High School, Washington, D. C.

Central States Group
NICHOLAS A. BAUER, High School, Adrian, Minn.

South Central Group
J. B. MCCONNELL, Southwestern Junior College, Keene, Texas

Western Group
RUBY PAINTER, High School, Alhambra, Cal

Prairie Group
R. L. KRUMMEL, Central High School, Kansas City, Mo.

Great Lakes Group
MAURICE V. KING, Jr., West Technical High School, Cleveland, O.

South Atlantic Group
EARL MCBEE, High School, Ensley, Ala

New England Group
LORREN G. HOOKER, Mt. Hermon School, Mt. Hermon, Mass.

New Jersey and Pennsylvania Group
GEORGE E. HAPPELL, High School, Saegertown, Pa.

New York Group
HENRY J. MACMILLAN, Central High School, Syracuse, N. Y.

Lorren G. Hooker
Mt. Hermon, Mass. Age 20

A Composite Best Paper

The composite "best paper" below is made up of the best answer to each of the ten questions in the scholarship contest paper. Some of the individual best answers were made by contestants who were not prize-winners.

Question 1. LORREN G. HOOKER, Mt. Hermon School, Mt. Hermon, Massachusetts

Atmospheric pressure causes a baseball to curve. The baseball is spinning, for instance, in a clockwise direction (direction of arrow within the circle *B*). The ball causes the air immediately surrounding it to spin with it (denoted by the four arrows outside the circle). The ball *B* is moving in the direction the arrow *D* points. Therefore the wind against the ball acts in the direction of the three arrows *W*. Thus, on the left-hand side of the ball, at *O*, the current of air caused by the spinning of the ball opposes the wind against the ball. This opposition of air-currents decreases the velocity at *O*, while the velocity on the right-hand side of the ball is increased by the wind. It can easily be proved (by blowing between two sheets of paper) that an increase in the speed in which air moves decreases the pressure. Therefore, there would be produced at *D* a low pressure, and at *O* a higher pressure. The ball, then, would move to the right. It would be an "inshoot" to a right-handed batter

Earl McBee
Ensley, Ala. Age 18

Question 2. R. L. KRUMMEL, Central High School, Kansas City, Missouri

When a boy jumps from a platform suspended from a large spring balance, the balance will show a momentary large reading. The explanation for this brings in one of Newton's laws, that of inertia. As the boy has been remaining in a state of rest, it takes some external force to change that state. The balance has been reading the earth's attraction, due to gravity, on the boy, or his weight. When he arises, he exerts a force with his muscles to counteract his inertia. Then comes another of Newton's laws, that in which "to every force there must be an equal and opposite reaction" and this reaction is supplied by the platform and the spring. Consequently, the difference between the boy's weight and the maximum reading on the scale will give the force he has exerted in rising

The Questions, Based Monthly for

1. (a) What makes a baseball curve? (b) Explain, in detail, the physical principles involved

2. (a) If a boy jumped from a platform suspended from a large spring balance, what effect would this have on the reading of the balance? (b) Explain the scientific principle involved.

3. (a) Explain how daylight may be closely imitated by the use of the "checkerboard reflector." (b) How will this aid industry?

4. (a) Explain the cause of the electrolysis of gas-pipes, and describe at least one way of preventing it. (b) How is electrolysis employed in electrotyping?

5. (a) Explain fully how you would construct a dry-cell from tinfoil. (b) Give some causes for trouble with automobile batteries.

Question 3. LILLIAN LEWTON, Central High School, Washington, D. C.

Artificial light contains more red and yellow light than daylight, and so causes objects to have different intensity of color in artificial light. This can be remedied by having a concave checkerboard reflector of blue, purple, and green. As the artificial light strikes the reflector, the blue, purple, and green will absorb the red and yellow light. This makes the resulting light just like daylight. Of course, the colors in the checkerboard will have to be arranged differently for the different kinds of artificial light to give the desired effect.

By this means an artist can paint at any time when he receives an inspiration instead of having to wait for daylight. In industries where color is a very important factor, such as the textile industry, it will be found very valuable and the work can keep on going after sundown.

Question 4. GEORGE E. HAPPELL, Saegertown High School, Saegertown, Pennsylvania.

Electrolysis of gas-pipes is caused by stray currents of electricity and the presence of acids in the soil. It generally occurs where trolley lines are present, the company using the rails for the return part of the current. Part of the current escapes

$5000 in Scholarships

proud of these young Americans

J. B. McConnell, Jr. Keene, Tex. Age 19 — R. L. Krummel Kansas City, Mo. Age 16 — G. E. Happell Saegertown, Pa. Age 17

on the Popular Science May, 1920

6. (a) With a diagram, explain the construction and operation of a searchlight. (b) Show how it may give a parallel or a divergent beam.

7. (a) Briefly describe the considerations involved in stepping down the voltage of an electric current. (b) Explain by a diagram how you would proceed to make a transformer for stepping down 110 volts.

8. (a) What are the forces which a grand-stand designer should take into consideration for the welfare of the public? (b) To what extent should a contractor meet these factors?

9. (a) Describe a freezer. (b) Why does melting ice freeze cream? Why is salt used?

10. What impressed you in "Fighting a Fire with Brains"? (b) What principle is involved?

from the rails and travels along gas-pipes in the vicinity. If the soil around the gas-pipes is slightly acid, electrolysis takes place and the metal pipe is decomposed and, unless the current is arrested, destroyed. One way to prevent or to lessen the electrolytic destruction of the pipes is to use negative feeders, i. e., regular conductors to carry the return circuit to the power-house. This can be accomplished well by using two overhead wires of different polarity—the current entering the car or locomotive by one and returning by the other. Another way to lessen electrolysis is by binding the rails together thus making them better conductors. The first method is the best, although the most expensive.

Everett Carman Washington, D. C. Age 16

For electrotyping, an impression of the type already set is made in plaster of paris or wax. When the plaster of paris impression has hardened, it is sprinkled over with powdered graphite, so as to make the surface a conductor. After suitably attaching a large copper wire to make connection with the graphite surface, the back and edges of the plaster of paris impression is covered with wax, if any graphite is on it there. Then the plate is hung in a solution of copper sulphate as the cathode of an electrolytic cell. A copper plate is used for the anode. A current of large amperage is then sent through the cell. The copper ions are deposited on the plaster of paris blocks and become copper atoms, making up a copper coating. When the coating is thick enough, the electrolysis is stopped and the plaster of paris removed from the copper.

The copper plate than has the same impressions as the original type and is known as an electrotype.

Question 5. Henry J. MacMillan, Central High School, Syracuse, New York.

Take an old battery apart, saving the carbon rod and the mixture of MnO_2 and graphite. Set the latter aside to dry. Take a cardboard tube about the diameter and length of a dry-cell and line it with several layers of tinfoil. Let the tinfoil come not quite to the top of the tube. Take a sheet of blotting-paper and cut it so it will fit inside the tinfoil. Allow enough so that it will extend an inch over each end of the foil. Be sure that it is large enough to cover the foil without leaving any part bare. Cut some disks of blotting-paper the same diameter as the cell. Place them in the bottom of the tube and fold the blotting-paper lining over them. Then place another one on top of them. Be sure all the foil is covered. Now take the mixture of manganese dioxide and graphite, and heat it, being careful not to let it get red hot, or over 400°. This is to re-oxidize the manganese dioxide. Stir it all the while it is heating. While it cools, make a saturated solution of sal ammoniac and thoroughly wet the inside of the cell, i. e., the blotting-paper. This should take twenty minutes. It is important that the paper be *thoroughly* wet. Now take the mixture mentioned above and, using the saturated solution of sal ammoniac, make a paste such that a ball of it will stick together. Heat the carbon rod to remove impurities which may be on it, and place some of the mixture in the bottom of the cell before putting the rod in. Then place it, and push the paste in tightly around it, until the paste is to the level of the top of the foil. Insert several more disks of blotting-paper, pour in about a half inch of melted paraffin, make connections from the carbon rod and tinfoil lining, and the cell is ready for use. Use it as you would any other dry-cell.

Question 6. A. Dexter Best, Adelphi Academy, Brooklyn, New York.

Although mirrors may be made so nearly perfect that we cannot detect any error, the searchlight will never throw a parallel beam of light because the source of illumination can never be a point. It must have area and therefore must make an angle with the mirror and the rays, instead of being parallel, diverge at this angle. This fact limits the range of searchlights, for otherwise the only advantage of a large searchlight would be in area illuminated. But the fact remains that to decrease the angle of divergence, the arc lights are placed farther away from the mirror, necessitating larger mirrors. The modern searchlight consists of a large parabolic mirror (some are five feet in diameter), a self-feeding arc light placed at the focus, a suitable body, cooling arrangements, and a glass front. Some of them have a focusing device enabling them to throw anything from a very wide angle beam to one nearly parallel, and very large ones have electric devices so that they may be controlled from a distance. Besides this, those for use on boats have a diaphragm and a shutter so that the size of the beam may be controlled and the light completely shut off without stopping the arc.

The focusing device is merely one to change the distance from the arc light to the mirror for if the arc is not at the focus the rays diverge, and the greater the displacement of the light from the focus, the greater the angle of divergence of the light rays.

Question 7. Robert Peary, Western High School, Washington, D. C.

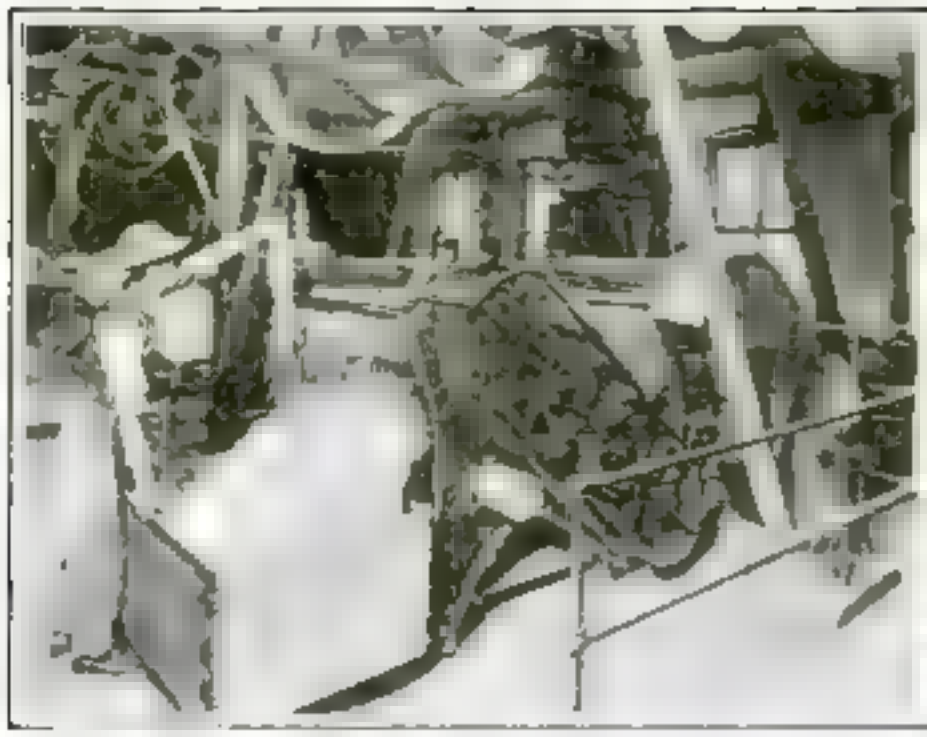
In stepping down a voltage, first and foremost, you must have alternating current. Then there must be a primary winding into which the original current is sent and a secondary winding in which the new current is induced. In the case of stepping down a voltage, the primary contains more turns of wire than the secondary.

First voltage is to second voltage as the number of turns in primary is to number of turns in secondary. An iron core collects and concentrates the lines of force.

Maurice V. King, Jr. Cleveland, O. Age 17

The core is made of some fairly heavy iron wire, heated to take out its temper, and shellacked to reduce eddy-currents. Around this is first wound the primary, enough turns of wire to furnish adequate resistance, also heavy enough to carry the amperes required. Next (after thoroughly insulating) the secondary is wound on, the number of turns being governed by the equation in *a*. For a fixed voltage, this is all that is necessary, but to vary this, taps must be taken off the secondary at different points.

Continued on page 90.



Getting the Wrinkles Out of Toilet Soap

SWEET smelling soap and slaughter-houses are closely allied. In fact, soap-making is part of the meat-packing industry. The picture shows the method of soap-milling used in one of our large packing-houses.

The soap—consisting of fats, vegetable oils, and caustic—is boiled, hardened on a chilled granite roller, and dried on screens. The resulting snow-white chips are scented and then milled between two granite rollers until they come out in smooth ribbon form.

A boxful of soap ribbons is shown herewith. An inspector is examining them to see whether they are sufficiently smooth. This is but a small item of the process that turns grease into soap.

This Balloon-Man Has a Nose for Business

TOY balloons on strings are such a common sight that the usual balloon-seller does not attract much attention. But there is one balloon-merchant in London who always has a crowd around him.

Why? Because he fills your balloon for you out of a compressed air tank while you wait. He holds the tiny rubber bag over the mouth of the air-tank and lets the air shoot in for a second or two. By the time he has a string tied around the opening, a buyer is waiting to take it from him.

Enterprise in business, if not elsewhere, usually receives quick recognition, so use your ingenuity to improve your business.

A Giant from Holland

IN our land there is a man of most gigantic size. But he did his growing in Holland, his native country.

This man measures eight feet, five inches. He wears a size nine and a half hat, a thirteen shoe, and a fourteen glove! It takes six yards of cloth to make him a suit. Johann Van Albert is his name, and you may expect to see it on billboards before very long, since he is going to join a circus.

What causes giants and dwarfs? Recent experiments have shown that the thyroid gland controls growth to a large extent. Young tadpoles have been made to grow to monstrous size by operations on their thyroid glands. Whatever the cause of Mr. Van Albert's height, he is certainly much looked up to in the world.

The Shoehorn Has a Companion

A HIGH shoe is easy to pull on, but not so easy to pull off. That's why this boot-remover was invented.

You place your foot securely in the groove and grip the handle tightly. When you pull up your foot, the shoe remains behind.

Tight pumps and ties may also be removed this way.

The lady in the picture above belongs to the tight-pump class. If she ever removes them, we doubt whether she will put them on again.

Serve Punch without Spilling It

WATER seeks its own level, and so does punch. The punch-server shown above is a glass bottle with an opening in the bottom as well as at the top. You lower it into the punch-bowl, and the punch flows in until the punch within is level with the punch without.

Place your thumb over the top opening and shut off the air-pressure. Remove your thumb when the bottle is above a glass and the punch will flow out.

He Couldn't Lose His Ball of String if He Tried

THERE [illegible] of killing a [illegible] than one way to tie up packages with string. A man in a large Chicago department-store has found a very good way of keeping the string at hand.

He probably thought of the idea when he saw his sister using a crochet-ball holder on her wrist.

"Why not use this method in the store tying the endless packages that I handle every day?" he questioned.

After he made the experiment, he decided to keep the string on his wrist, where it would accompany him wherever his duties carried him.

People now carry watches and memorandum pads on their wrists. Why not carry a ball of twine? Forgetful people would be saved much trouble if they would keep the articles that they constantly use attached to their person.

Working Safely on High-Voltage Lines

YOU can touch a high-voltage wire in safety if you are standing on a non-conductor, such as dry wood. That's why the small wooden platform shown above was built.

The workmen standing on it must make repairs in the midst of wires carrying as high as seventy-five thousand volts. The platform is made of specially treated wood and it can be adjusted to any height on the pole. Should the workman touch a high-voltage wire, the current would be grounded.

You Can Restore Carbon Paper with a Hot Iron

CARBON paper treated with heat brings it back to a useful condition.

Two sheets of worn carbon paper are placed together face to face, but tear [illegible] back.

The sheets are then placed on a flat surface and covered with a piece of thin paper. They are then ironed out with a hot flatiron and pulled apart before they become cool.

Renewed in the manner described, carbon paper will give considerable service before it becomes necessary to relegate it to the waste-basket.

The temperature of the flatiron must not be too high or the paper will be ruined.

If one attempts to pull the paper apart before it has cooled sufficiently, it will tear.

Wheel-Guards that Save Life

PEOPLE cannot be killed by freight-cars if the cars are equipped with wheel-guards like those shown in the picture.

As the car comes along, the guards hang in a horizontal position at the end of arms just above the tracks. But as soon as they come in contact with a body, counter-balances cause them to drop so that they touch the tracks. They automatically throw the body aside—and the car continues on its way. The man gets up, brushes off his clothes, and decides his hour has not yet struck.

The inventor of this guard, Adam Cantion, once saw a fellow railway worker killed, and was not content until he had succeeded in inventing the safeguard described above.

Trapping Wasps in a Glass

A FLOWER-POT, a jelly-glass, a saucer, and three small wooden blocks make a splendid wasp-trap. The saucer filled with sweetened water, is placed on the table. The flower-pot, inverted, rests on the wooden blocks and partially covers the saucer. The jelly-glass, also inverted stands on the flower-pot.

Along comes the wasp. He drinks the sweetened water, flies upward, and is trapped in the flower-pot. He sees light through the hole in the pot, and crawls through into the jelly-glass.

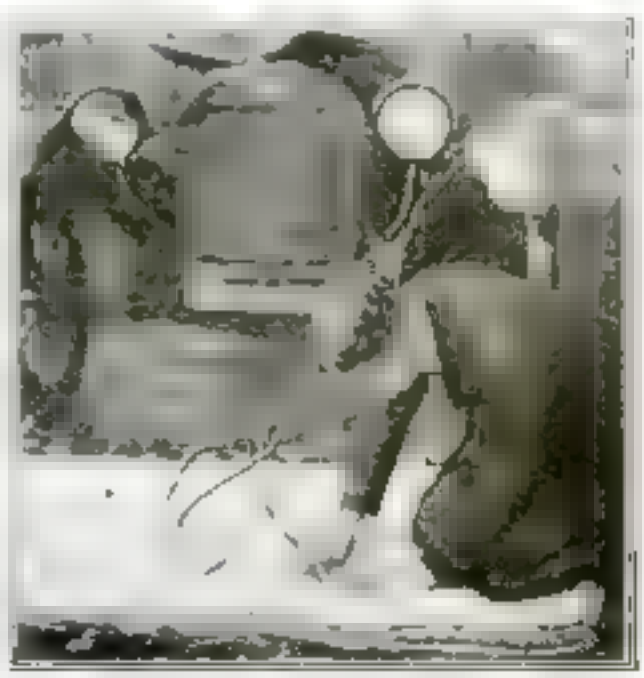
By thrusting a sheet of paper between the glass and the pot, you prevent his escape when you remove the glass.

The Air-Hose Cleans House

IF you have an air-pump on your car, driven from the engine, you will find it useful for many things besides flat tires. It will clean mattresses and upholstered furniture just as effectively as a vacuum cleaner, though its action is entirely different.

Instead of sucking in the dirt, the hose of the air-pump blows the dirt off. However, since it is used out of doors, the flying dust does no harm.

The air-hose can be used also for spraying paint. The nozzle is placed inside a can containing paint, and the force of the air causes the paint to issue forth in the form of a spray. This method of painting saves a great deal of time.



A Lake that Has a Crust of Salt

GOING through the weird region of Death Valley, in California, travelers looking from their perch upon a hill where a wide view is commanded, may see what appears to be a lake of ice gleaming in the sunlight.

When the lake is reached, one finds it to be not of ice, but that it has a crust of salt. The surfaces of these lakes are wet in winter and dry in summer, where drainage from surrounding highlands pours upon them the flood of winter rains. Evaporation is rapid in this region, and by the time the dry season begins many of the lakes have become crusted with hard salt.

In spite of this abundance, it is said that Europeans introduced the use of salt to the United States.

Measuring the Amount of Evaporating Moisture

IT is necessary for the farmer to know how rapidly the moisture in his part of the country evaporates. And he is able to find this out by using an evaporometer. Mr. C. G. Bates, of the United States Forest Service, has recently invented one, and it is shown above.

It consists of a small seamless metal tank seven inches high—to which a wick is attached.

The tank is filled with water which escapes through the wick and subsequently evaporates. An indicator on the tank shows just how rapidly the water disappears.

The amount of evaporation is due to several causes, chief of which are, of course, wind, sun, and temperature.

Screw-Nuts Tame Horses

A FARMER in Oakland, Oregon, had several horses that defied all barriers and wandered into his or his neighbors' wheat crops.

One day, he found a large rusty nut, about two inches square. He looped a string through the nut and tied it to one of the horse's forelocks. The horse ducked its head when released; the nut gave him a whack above the eyes. He trotted staidly, the nut remained still.

Now all the horses have large nuts tied to their forelocks, and they behave as well mannered horses should.

Buy from the Silent Salesman

"STATIONERY" reads a sign on top of a small cabinet in the lobby of a hotel or in a store. It tells you where to get paper and stamped envelopes.

The cabinet is a silent salesman, ever at the service of the one who would buy stationery. When you go in and ask for an envelope, the clerk points to the corner of the room and says, "There's the cabinet, help yourself."

A plain box arranged to hold the needed stationery works automatically, and furnishes a stamped envelope and writing-paper.

Is There Paper in Your Shoes instead of Leather?

THE shoe below looked like an all-leather one, but when it was ripped open, paper was found in several places. When you wish to test a pair of shoes, press a pointed knife against the leather. If it sinks in easily, you'll know that there's paper present. Unfortunately, very few dealers will permit you to make such a test of their merchandise.

By substituting paper for leather wherever possible, a manufacturer of cheap shoes is able to use a better quality of leather in the parts that are most subject to wear.

Paper is widely used for the upper layers of the heel. The bottom layers are nearly always leather, to give better wear.

A Stethoscope for Telephones

"PLEASE speak louder. I cannot hear you."

It will no longer be necessary to strain your hearing over the phone. This new sound-amplifier makes it possible to hear long-distance calls in a noisy room with perfect ease.

The device is not electrical. It operates on the principle of the physician's stethoscope.

Place the telephone receiver on the pneumatic receiver, with the two rubber tubes leading from it placed in the ears. Even the faintest sounds will be heard.

Taking the Drip Out of the Candle

CANDLES, though cheap, should not be wasted. And the best way to prevent waste is to prevent dripping. Here is a new dripless candle-holder.

A metal cap fits over the wick end of the candle and keeps the melted wax from running down the side. In fact, a small pool of wax collects in the cap, feeding the wick as long as the wick will burn

The cap slides up and down on a back support, automatically adjusting itself as the candle diminishes.

© International Film Co.

Put Your Shoes in the Boot-Lock

IF you leave your dusty shoes outside of your door when you stay at a hotel, you may find them shining in the morning light or you may never see them again; the chances are about even.

But there is now a new boot-lock that can be attached at the side of a door. You put your shoes in it, and only the hotel valet knows the combination.

Shoes are too valuable nowadays to be treated lightly, and the new boot-locker will ease the minds of hotel inhabitants

Bale Sheet-Metal Scraps

BALE your sheet-metal scraps and you will find them easy to dispose of. A small press that will do the job well is shown below

The scraps are dumped into a hopper at the end of the machine, and when it is full, the lid is closed down. Next, the press is set in motion by a crank-lever and in ten seconds the bale is finished!

The press is so constructed that it exerts pressure on four sides at once, causing the scraps to cling together.

To guard against damage through overloading the hopper, the press is provided with a cast-iron block that will break if too much strain is placed on the press. Five horsepower is needed to run the press, which weighs thirty-five hundred pounds. It can be mounted on a truck and moved from place to place.

Punching for Votes

VOTE by machinery—that's the latest. Instead of filling out a ballot by hand, you punch a button directly under the name of your candidate.

Your own voting number has already been adjusted on the machine; thus both your number and the name of your candidate are registered.

The tedious job of counting ballots is eliminated. Will the taxpayer be content to let a machine vote for him?

The Reverse of That Adage About Oil on Troubled Waters

NOW that ships have begun to burn oil instead of coal, the danger of fire in and around harbors has been greatly increased.

Although it is against the law to clean ship tanks and bilges near docks, seamen persist in doing it. At Brooklyn, New York, a thick layer of oil can almost always be seen around the repair yards. As a result, many fires—some of them serious—have broken out there. A lighted cigar thrown on the water is enough to start a fire, as the oil floats on the top of the [illegible].

Drinking-Cups for Cows

UP-TO-DATE dairies have individual sanitary drinking-cups for cows, instead of the old-style buckets connected with the same supply-pipe. If any animal was diseased, the germs would be carried from bowl to bowl.

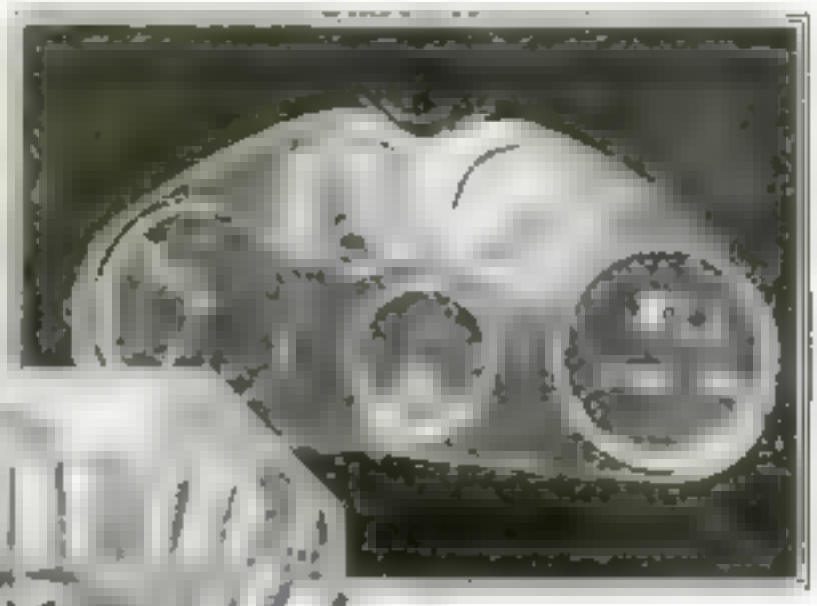
This new drinking-cup is a small iron basin just large enough for a cow. In the bottom there is an adjustable steel plate.

The water comes from a pipe above the rim of the bowl; thus no germ can float back into the supply system. A valve keeps the water from constantly flowing into the bowl. When she is thirsty the cow puts her nose into the bowl and presses down the steel plate. This pressure opens the valve and the water runs into the bowl. The water will run in as fast as the cow can drink it

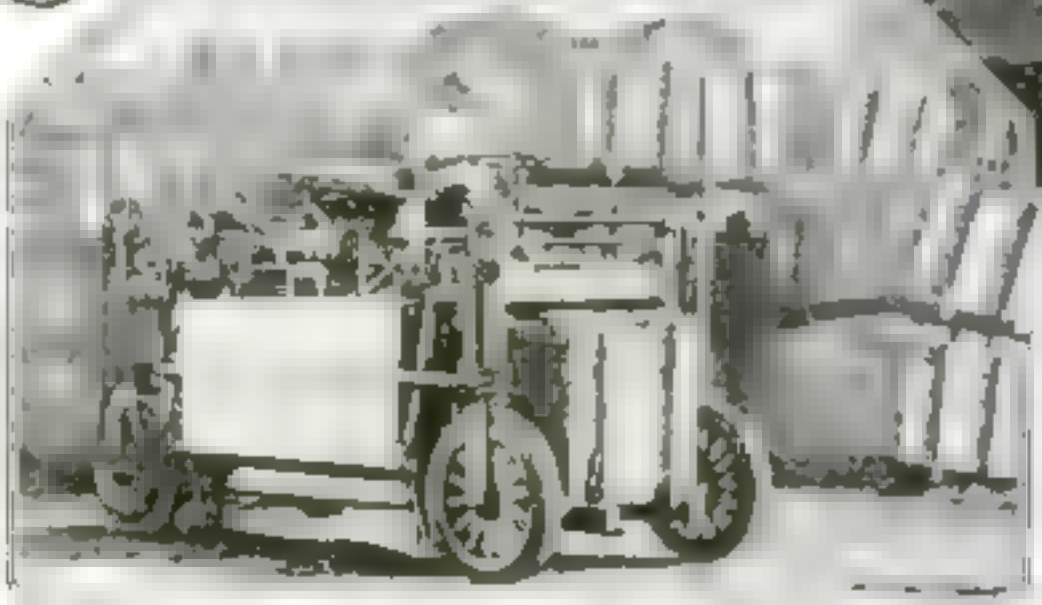
What's New in the

Economy is the watchword of

The desert service station at Yuma, Arizona, seems [illegible]



At first glance the grade indicator seems nothing more than a curve of glass tube [illegible] with red [illegible] but it is a scientific instrument [illegible] cutting of what grade the car is ascending



This cheer cuts hauling costs in the lumber industry. It runs over a wide [illegible] the lumber [illegible] on its way. It is operated by storage batteries

[illegible] Here is a brand new [illegible] Transmission [illegible] by the [illegible] by [illegible] drive [illegible]

At the Wyoming State Fair at Cheyenne a Ferris wheel was run for a week by belting up a small track-laying tractor of the kind used on farms

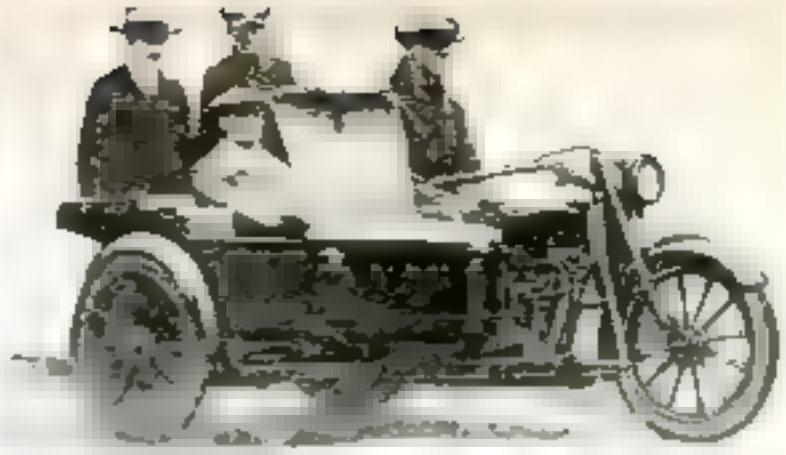
[illegible] mechanics to operations to prevent it from functioning

[illegible] cleaning. A new vacuum cleaner operates from the automobile's exhaust, and embodies the vacuum bowl, hose, and brush nozzle

Automobile World?

these accessory manufacturers

This new tire [illegible] covered by a [illegible] cap [illegible] pump [illegible] and tells the air pressure at a glance



Averaging [illegible] miles [illegible] passengers [illegible] cycle [illegible] recently between New York and Atlantic City [illegible] passengers and [illegible] weighing 500 pounds

By swinging the doors at the front and rear of this sedan instead of at the center, only [illegible] and leaving the automobile

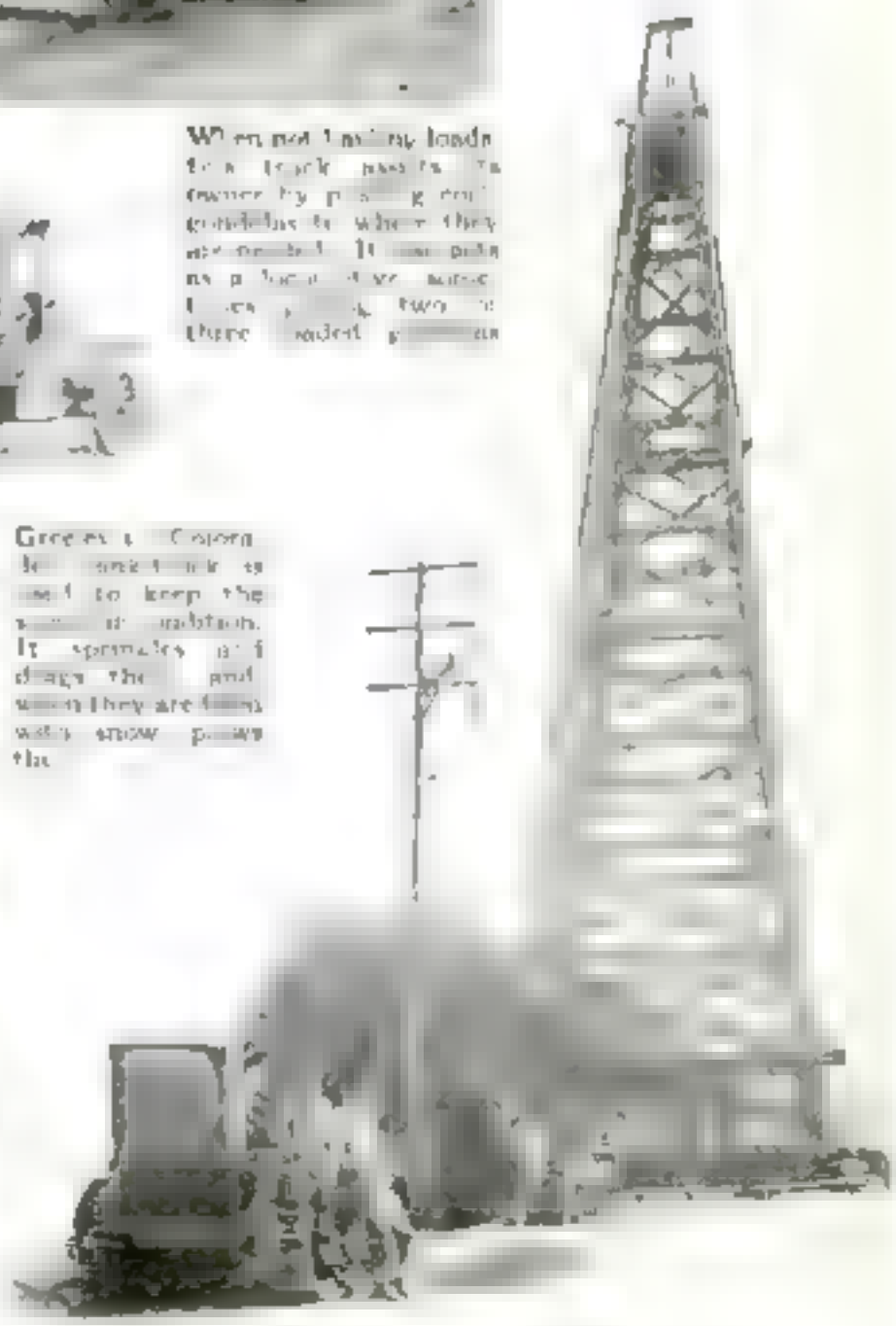
In a new type of spring lubricator a piece of woven fabric is wound around the spring and covered by a leather boot. The oil is fed through a filler-cap

When not [illegible] loads [illegible] truck [illegible] owner by [illegible] gondolas to where they are needed. It [illegible] as a [illegible] two or three loaded [illegible]

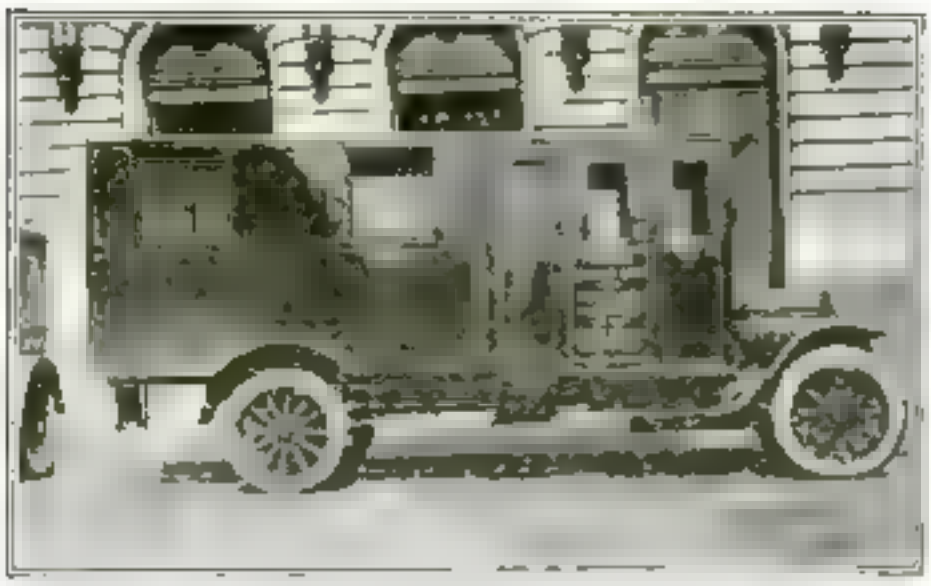
A novel washer for automobiles has a hollow handle attachable to the garden hose. The water rushes out through the revolving brush and with the continuous flow cleanses without scratching

The deeper a tire sinks into the mud the harder [illegible] this [illegible] gripping device pull as it [illegible] sideways into the mud

Greenest [illegible] Colorado [illegible] used to keep the [illegible] radiators. It sprinkles and [illegible] the [illegible] and when they are [illegible] water snow [illegible] the



In California the tractor that carries the oil derricks to the wells is coming into prominence almost as fast as the oil-wells



No bandit can get inside this armored car; the body is of steel, with a layer of asbestos

Your Money Is Safe in the Bank Tank

THE Cleveland Federal Reserve Bank has put into service the "vault on wheels" shown in the picture.

It is an armored truck having two compartments. One, in which the driver and chief of guards ride, has no bars. The second compartment in which the cash is carried, will carry as many as eight guards. Folding seats extend along the sides as in the ordinary patrol-wagon. Gun-racks, dome lights, and speaking-tubes complete the appointments.

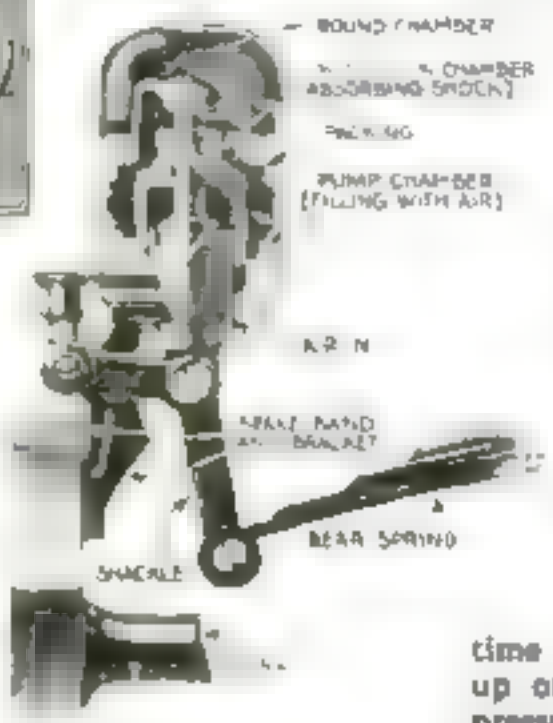
The entire body is encased in a bullet-proof coating consisting of an outer and an inner layer of heavy steel having a layer of asbestos between. This armor cannot be penetrated by a pistol projectile of the highest caliber.

Taking Out the Bumps

WHILE the pneumatic shock-absorber for Ford cars is more expensive than devices of the spring or lever type, this is more than offset by its better riding qualities.

As shown in the cross-sectional view, the apparatus is made up of a compound cylinder composed of three separate cylinders. The first is a pump-cylinder from which the air sucked in on the down stroke of the piston is forced into a compression-chamber to absorb the shock. Once the shock has been absorbed, the pressure of the air in the compression-chamber is relieved to permit the rebound chamber, at the extreme top, to absorb the shock of the rebound.

The piston-rod of the lowest chamber is attached to the regular Ford shackle as used on the front and rear springs. As this piston-pump is set in motion each time the end of the spring moves up or down, it sets up an air-pressure in the other two cylinders, which is automatically maintained by the up-and-down movement of the car when it passes bumps. Each absorber works independently, so that the varying intensity of the shocks is taken up by each absorber individually.



For the Ford comes this new type of shock absorber, which is made up of a compound cylinder embodying three separate cylinders. Although it is more expensive than the spring or lever type, this is offset by its better quality

The Tractor in the Lumber-Yard

IN the present state of high prices of horses and mules, many lumber-yards and sawmills are turning to the small gasoline tractor.

Owing to the special tasks to be performed, not every small gasoline tractor will give good results. Some do not secure sufficient traction in rainy weather; others do not have sufficient pulling power; and still others cannot turn in a small enough radius to permit of quick work in the narrow lanes between the lumber-piles.

The tractor shown in the accompanying illustrations is the invention of two lumbermen, S. K. Prescott and H. A. Thurlow, of Seattle. They claim that the tractor will do the work of from three to seven horses and mules, at a cost less than that for one horse or mule.

The machine can perform many kinds of work. It can pull two-wheeled lumber buggies, three-wheeled lumber buggies, or four-wheeled wagons, move small timbers with a grab-hook; push lumber buggies and other loads, pull heavy timbers; and spot railroad-cars.

While the tractor is not in any sense a rebuilt automobile, it is fitted with a Ford engine, which is so geared through a sprocket-and-chain drive that it delivers between fifty and sixty horsepower to the rear wheels. This power is delivered eleven inches off the ground, giving the machine an exceptionally strong drawbar pull. The Ford motor has been found particularly well adapted for lumber-yard hauling because of the foot gear-shifting mechanism, which enables the driver to get under way with a load very quickly.

A truck type of radiator with double the cooling capacity of the Ford passenger-car type is fitted to prevent the engine from overheating under steady pulls. A guard in front of the radiator permits loads to be pushed as well as pulled. At the rear of the tractor is fitted a special swivel-bar with a wire rope and winch to support and regulate the front end of the load when carried on a two-wheeled dolly.

With its small but powerful engine the tractor is adaptable to a great variety of work easily serving other than lumber manufacturers.

Equipped with a Ford motor, this baby tractor is so geared that it delivers sixty horsepower to the rear wheels

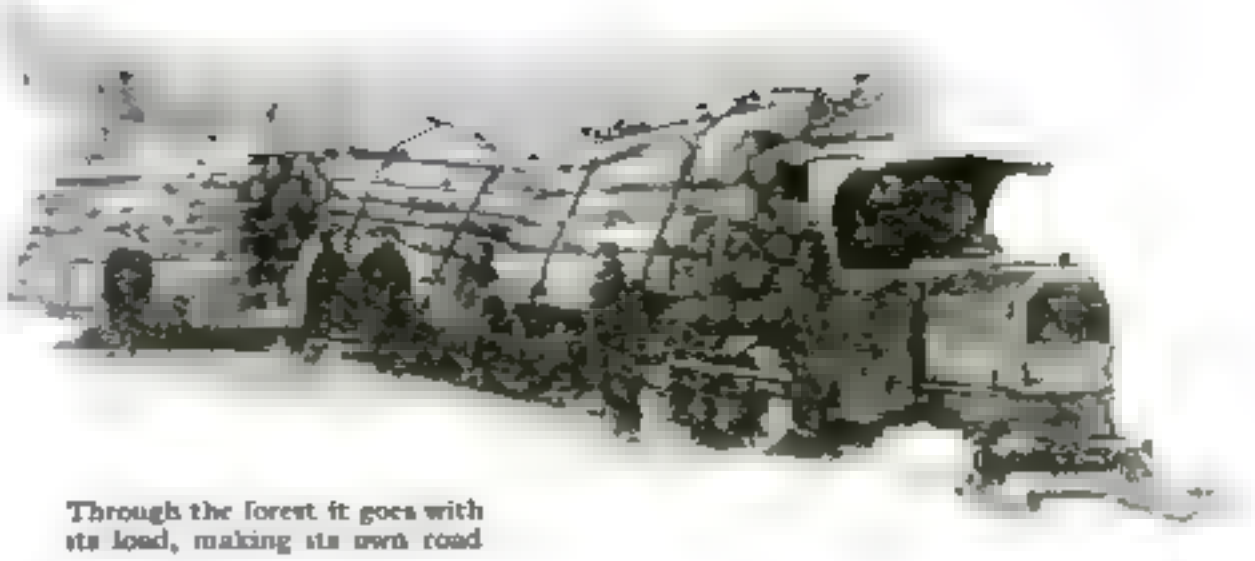
The machine performs many kinds of work in the lumber-yard, it is not a rebuilt automobile, and it does seven horses' work

Protecting the Driver from the Elements

A TENDENCY is abroad today toward the greater use of closed cabs on motor-trucks in order to protect the driver in rainy or snowy weather. Most of the completely enclosed truck cabs, however, are fitted with door units, which must be removed in hot weather. Sometimes they become mislaid or damaged

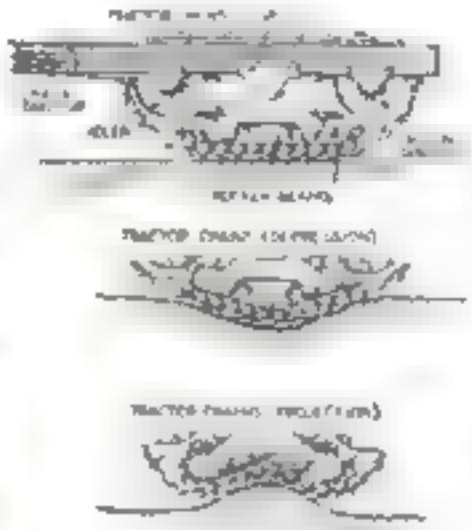
To overcome any need for storing the doors away when taken off, an Eastern truck-maker has devised a removable cab door made of leather, which can be folded like the side curtains of an automobile and placed under the driver's seat.

An enclosed cab for the driver made possible with detachable door units



Through the forest it goes with its load, making its own road

A Flexible Track-Layer



In this flexible track-layer the cleats follow the curvature of the ground touching it at all points and giving a greater traction when most needed i. e., when passing over depressions

THE track-laying wheel shown in the accompanying illustrations is different from all other types of similar devices in that the tread is flexible and follows the contour of the ground, instead of being rigid, such as was the type used on the British tanks.

There are certain advantages of the flexible type, especially when applied to a vehicle intended for commercial hauling, such as logging work, pulp, and chemical wood haulage, and the like. With the rigid type of track-layer, the tread must span a depression in the ground or crush a projection. When it spans a depression almost equal to the length of the tread itself, the track-layers only touch the ground at each end, thus reducing the amount of traction by decreasing the area of tread.

With the flexible type, however, the cleats follow the curvature of the ground and touch it at all points, so that the traction is greater when passing over a depression than when traveling on level ground.

An Underground Gasoline Storage-Tank

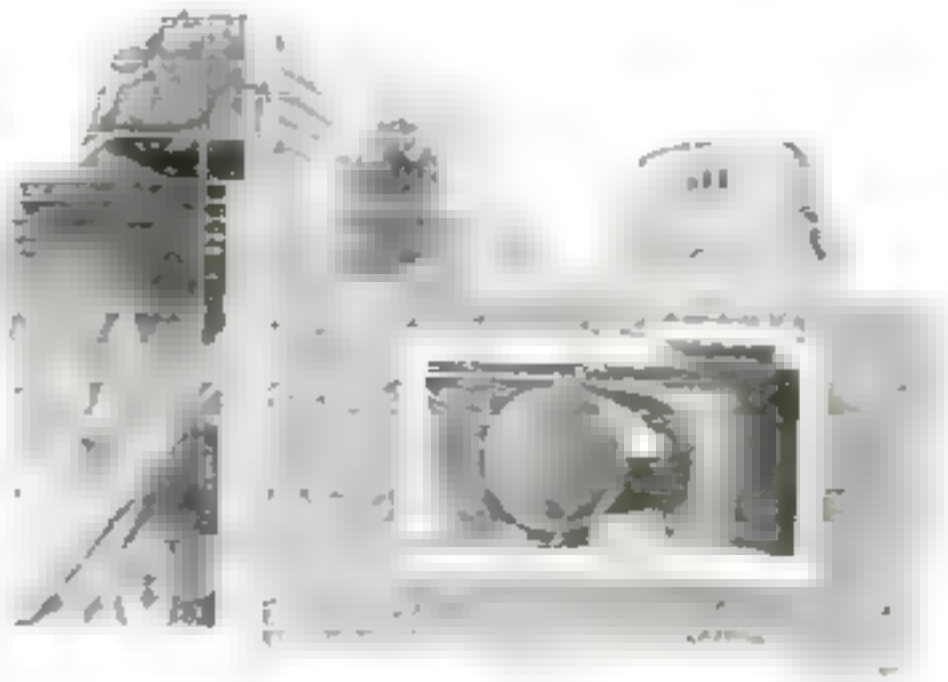
PUT-PUT your engine gasps and then dies. You waste an hour going over the engine, the ignition system, and then decide that it must be dirt in the gasoline feed-pipe. You spend the rest of the day under the car.

Clean, filtered gasoline is absolutely essential to the good running order of your car If you have a garage of your own, build an underground gasoline storage-tank near it and keep your own gasoline supply You can filter and drain it yourself.

An excellent storage-tank is shown herewith It is located in a small concrete cellar and receives its supply of gasoline through a pipe that terminates aboveground. The pipe has a strainer attachment. There is a drain-pipe at the bottom of the tank that carries off any sediment that may have got into the gasoline.

There are two more pipes attached to the tank an air-inlet pipe and a gasoline-outlet pipe. Both of them lead to the garage. When you wish to draw up some gasoline you connect the air-inlet pipe with a tire-pump and send a supply of air into the tank This will force the gasoline into the outlet pipe and it will soon be flowing into the tank of your automobile.

An underground storage-tank has several advantages over a tank built aboveground. For example, it is free from dust, dirt, and rain, and there is decidedly less risk of explosion, to say nothing of the additional floor space.



When wishing to draw a supply of gasoline from this underground tank, pump air into it and the gasoline is forced out

Providing an Ocean Liner with Listening Ears

AN ocean liner is coming close to port and a dense fog blankets the sea; yet the engine is running at a scarcely noticeable reduced speed.

"What a reckless pilot!" might be your thought. But if you stepped into the cabin where the navigating officer is listening to what the telephone receivers have to say, a remarkable condition is disclosed. Not only every vessel within a radius of about fifty miles whose propellers are working, but every lighthouse signal station or bell buoy, can be heard. From the direction of the sound and its intensity, the inbound steamer can be safely steered through the fog. Not only that, but the depth of water in which it is moving can be gaged, provided the water is not more than one hundred fathoms deep. "How is this wonderful result accomplished?" asks the uninitiated.

The captain of the *Breckinridge* and H C Hayes, one of the inventors, listening in on the hydrophone

Installed on a ship the hydrophone indicates the approximate depth of the water, as well as discloses the presence of other craft. It can also be used to communicate with passing aircraft, and is, in all, a wonderfully useful instrument

The hydrophone, as used for sounding the depth of the water, consists of a set of microphones which are placed in a tank in the keel of the vessel, totally submerged.

In the forward part of the vessel, at a known distance from the ship's center, is the registering part of the instrument, consisting of a dial that points out certain angles of a semicircle. Aft is the propeller, the noise of which is reflected from the bottom of the water.

The angle of reflection equals the angle of incidence, in sound as well as in light, and this angle is indicated on the dial

The reflected sound, reaching the microphones, causes the dial to move with the shifting of the ship's position, as the sound is sent back from the various planes of the sea-bottom.

A simple calculation, arrived at from a table, enables the navigator to chart the region over which the vessel is passing.

The One-Man Submarine Is Here

OUT from the fleet darts the *Sea Hornet*. It is a mere speck, barely visible, like a small raft moving at great speed, showing only six inches of surface above the water.

The *Hornet* is a one-man submarine which travels at a speed of 30 knots and carries a torpedo charged with from 300 to 500 pounds of T N T. The length of the submersible is 40 feet and its weight is 8500 pounds. The crew consists of one man. He pilots the craft and directs and fires the torpedo.

In firing, the gate at the bow is raised by means of a latch controlled from the conning-tower, thus admitting the water to the torpedo-chamber. The mechanism of the torpedo is started and the deadly missile is directed upon its course. Then the gate is closed and a powerful pump operated to remove the water from the compartment. Just forty-five seconds are required to get the submarine ready to speed up its engine of 200 horsepower At 30 knots an hour it swings back to the protection of the fleet to receive a new charge

This interesting invention was designed by W. B Shearer. The miniature submarine can travel on the surface, and from its size might be mistaken for a motor-boat. Submerged, its forward deck is entirely concealed and barely six inches of the rear portion of the boat projects above the water.

Only from the air would it be easy to detect the *Sea Hornet* going on her "lawful occasions."

When she is submerged, the forward deck of the miniature submarine is entirely concealed and barely six inches of the rear portion of the boat projects above the water

The one-man submarine is scarcely larger than a motor boat It is a trim little craft above the water with a speed of thirty knots an hour

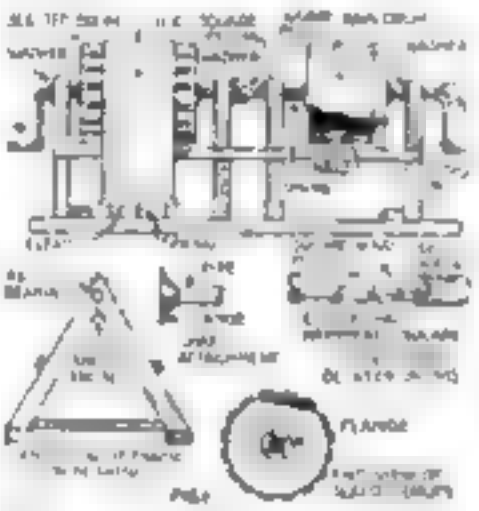
The gate in the bow of the submarine opens, the torpedo shoots out and the gate closes A powerful pump ejects the water that entered the torpedo-chamber

Imitating Rain, Thunder, and Snow for Amateur Theatricals

By **Lawrence B. Robbins**

MANY effects simulating nature on the stage are made by the orchestra, but there are a few that call for special appliances. On the professional stage these are somewhat complicated, but for the wants of the amateur actor the machines herein described will give those effects very realistically and will be found simple to construct. Much of the naturalness of certain scenes can be realized by their use and the continuity of the entire play improved.

Figure 1 represents a machine for reproducing both wind and rain, either singly or in combination. It consists of two revolving drums mounted upon a frame of heavy timbers. Four triangular sections of the frame are first built of 2 by 4 spruce after the pattern shown in detail. The axle-bearing should be about 36 in. from the floor. Bolt the peaks together and brace the under part with an angle iron. Leave the bottom or base open until assembled upon the base timbers.



This machine imitates wind and rain, there is nothing complicated about it

For the wind effect build a slatted drum 18 in. in diameter and 24 in. long. This is constructed of two circular disks of heavy wood. Then nail slats around their circumferences, completely enclosing them. Leave about one inch between the slats, and sandpaper them off smooth so no splinters will show themselves. Bolt a pipe flange in the exact center of each disk and thread in a piece of 1½ in. piping for an axle. These two pieces of pipe must be in line so as to make a true running axle. Slip a couple of washers on each end. Then construct a crank for one axle with elbows and short lengths of pipe as shown. The extreme end of the other axle should be heated to redness and pounded into a rectangle (square).

The rain drum is composed of a circular box similar to that shown. Nail metal lathing around the entire inside or drive in small wire nails. Put in about a pint of dried peas or old shoe buttons. Arrange pipe axles on this drum the same as on the other. These axles should be somewhat longer than the others. A crank is constructed for one end similar to the one for the wind drum and a square wooden plug driven into the open end of the opposite axle. Make it of hard wood and of a size to fit in the squared end of the wind-drum axle. Secure it with a set screw. Set a spiral spring over this end of the axle with a pair of washers and two washers over the crank end.

Now set the axles of each drum in a pair of the frame sections, arranging the washers in the wind drum so there will be no end play to mention. The washers and spring should be placed between the frame section and one disk of the rain drum; the washer on the opposite axle being held in place on the axle at a definite point by a cotter-pin. This allows the axle to be pushed along the length of the spring but no farther.

Next, build a base of four timbers bolted together and arrange the position of the four section frames in the relation indicated. Set the rain drum just far enough away so that the spring holds it from engaging with the axle of the wind drum, but will engage with it if the axle is pushed in. Throw a sheet of silk over the wind drum and secure it to the base at one end with light springs as shown. Hang a weight on the other. Thread on the cranks and secure with set screws. By turning the cranks of either drum separately you will get the effect of whistling wind or beating rain and by engaging the two axles and turning both at once the combination of both is produced together. Nail a brace each side of the frames and the machine is done.

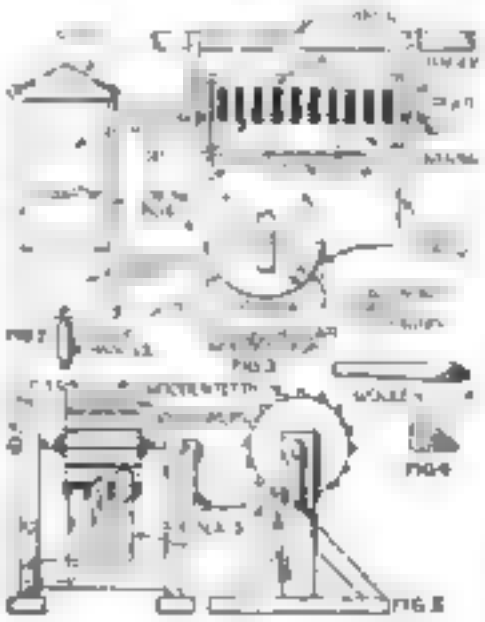
This is accomplished by suspending a sheet of iron vertically, clear of obstructions, and shaking gently or hard according to the intensity of sound desired. Rivet a wooden cleat to one end and attach a rope to hang it by. A looped rope in the lower end will serve to vibrate it. A sheet the dimensions given will give a good imitation of thunder.

If the storm occurs in winter and snow is supposed to fall, the following will give the effect very realistically. Cut out two semicircular pieces of wood and connect them with a covering of sheet iron, cardboard, or stiff roofing paper. Set in a couple of ribs to give shape to the middle of it. Then cut a row of slots 6 in. long fairly close to each edge. Make them 1 in. wide and as far apart. Pivot the top of each end of this container through a piece of wood and nail these hangers to an overhead beam behind a border scene. By partly filling this with fine white paper and rocking back and forth by pulling on the pull cords attached to each end, the paper will sift through the slots and fall to the floor as desired.

The operator can furnish the actors with wind, rain, thunder, or snow

Suspend this arrangement at one end of the stage and set an electric fan beyond it and the wind can be made to blow it by a window or open door as though driven by a gale. Operating the wind machine with it will add to the illusion.

A policeman's rattle is a good example of the idea used in imitating falling or splitting timbers. Saw off a section of round log about 15 in. in diameter and set axles on each face as previously described for the wind and rain machine. Then screw hard wood teeth around its circumference at right angles to the sides. Make of hard wood and with a cross-section as shown in detail. Build a frame of 2 by 4 timber as illustrated in Fig. 5 and mount the axles in holes for bearings in the uprights. A cotter-pin in one end of the axle will prevent it from pulling out the bearing. Make a crank of pipe-fittings for the opposite end.



All of these machines are operated by a handle

Three strips of oak 4 in. wide and ½ in. thick, and long enough to strike three separate teeth of the drum when arranged as shown under the drum, will furnish the clatter

An Out-of-the-Way Clothes-Rack

Out of the way when you don't need it, but ready for instant use

By Theron P. Foote

PERHAPS one of the most useful household articles I ever turned out with my own hands is the adjustable, collapsible, and out-of-the-way clothes-rack.

"A common, ordinary clothes-rack," you will say. "Anybody can string a clothesline across the kitchen for service when the rain is pouring down." Yet this clothes-rack accommodates a large washing, and once the wet clothes are on the rack, the whole rack is pushed up into the hot air next to the ceiling and the clothes are entirely out of the way.

Nine 4-ft. sticks, preferably of seasoned ash, each ½ by 7/8 in., highly sandpapered to a very smooth surface and the sharp edges rounded off are the first requirements.

Drill a 1/8-in. hole ½ in. from one end of each stick in the center of the ½-in. side, and with a large flat-sided hasp round off the end. See Fig. 1. These pieces are the clothes arms and are riveted to a movable support.

From a 3-ft. piece of oak, 1½ by ¾ in., cut two pieces as shown in Fig. 2. A 1/8-in. drill-hole ½ in. from each end furnishes a clearance hole for the wood-fastening screw so that it will not crack the wood. Six inches apart, 3 in. from the center line are two ¼-in. holes drilled only ½ in. deep, while directly on the center line, but in only one of the pieces, is a ½-in. hole all the way through. Two strips of wood ⅞ in. square by 30 in. long, and two brass rods each ¼ in. by 31 in. long, separate the two sticks shown in Fig. 2 and form a framework of the stationary part which is fastened to the wall. See Fig. 3.

It must be understood, however, that before this framework can be completely assembled and fastened to the wall, the movable part must be placed on the rods.

This movable part is composed of eight pieces of wood and is shown in Fig. 4. Part I is a piece of ¾-in. oak 8 in. long and 3 in. wide. To the ends of this piece are securely nailed two 9-in. strips ¾ by ¾ in., allowing 1 in. to extend beyond one side of the strip (Part I) and 5 in. on the other side. These strips are marked Part II and Part III in Fig. 4. One half inch from each end of the strips drill a ½-in. hole ¾ in. deep and a ¼-in. hole the rest of the way through. Part IV is a hard piece of oak 7⅞ in. long, 1½ in. wide by ¾ in. thick, having ¼-in. holes all the way through, the holes being 6 in. apart. If the center line of

When open, the clothes-rack accommodates a surprising number of clothes

these holes is ⅝ in. from the back side of the block, this will allow a clearance of ⅛ in. between Part IV which slides up and down on the brass rods and the wall on which the standard is mounted. (Note in Fig. 2, that the ¼-in. holes are ¾ in. from the back side of the strip. A ½-in. hole is drilled in the center from the back and is only ⅜ in. deep. Parts V and VI are two 14-in. pieces of oak ⅜ by ⅝ in., having ¼-in. clearance holes drilled on the ⅜-in. side in the ends. Parts VII and VIII are 7-in. pieces of ½-in. round rod.

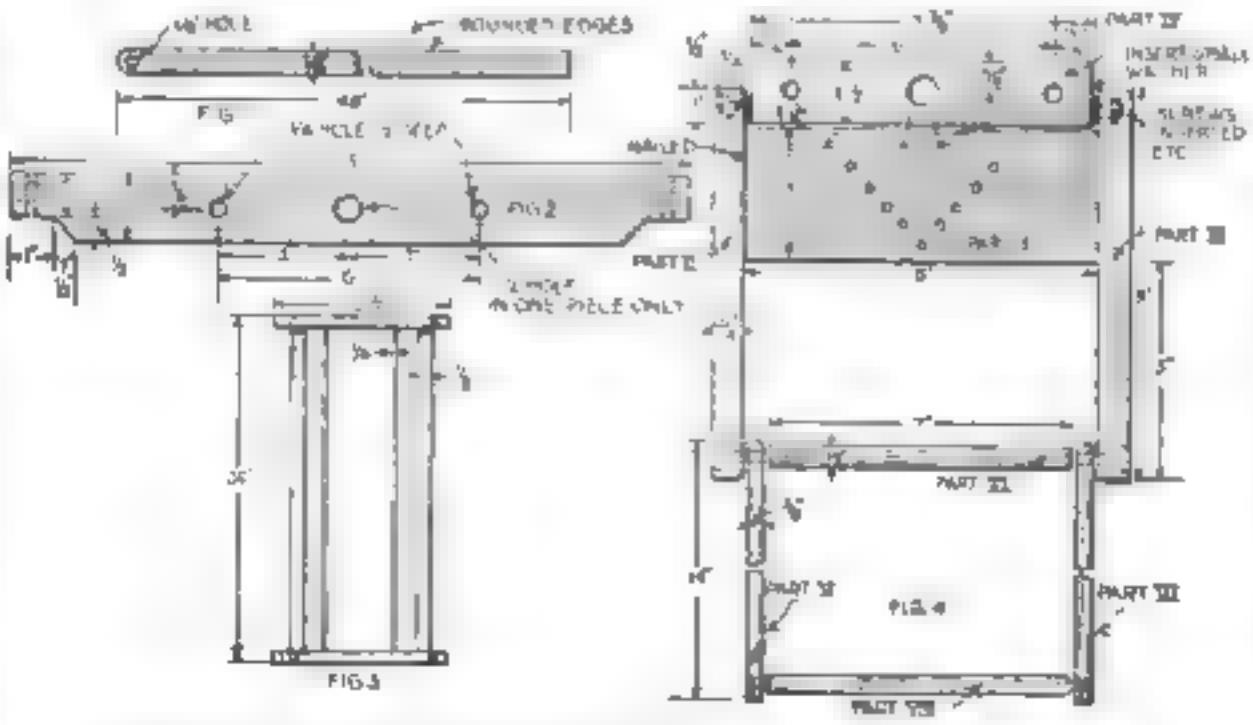
After assembling these eight pieces, the ends of the clothes arms having the ½-in. holes, and as shown in Fig. 1, should be placed on Part I of Fig. 4 and spaced to form a V. This will allow a free movement of all rods when open, while when the rack is closed the rods will fit closely together.

One-eighth-inch iron rivets, 2 in. long and having suitable iron washers to fit, fasten the clothes arms to their base. (Part I, Fig. 4.) In riveting, first place a washer on the rivet next to the head, then the rivet through a clothes arm, then another washer, then through the base, then another washer. Inverting the whole thing and placing the rivet head on a metal foundation, hammer over the end. This operation must be done with each clothes arm, and when the nine clothes arms are securely riveted on the movable support, the whole is placed on the brass rods of the wall support. One end of a ½-in. round rod 36 in. long is glued and nailed in the ½-in. hole (1⅛ in. deep in Part I of the movable part) and protrudes through the ½-in. hole in the bottom piece of the standard. By means of this rod the movable section is pushed upward on the rods. A small piece of brass wire bent so as to spring into the position shown in Fig. 5 is sufficient to hold all the weight one could place on the rack without breaking it. In letting the rack down from the ceiling, simply press in the spring wire catch and the rod (having the movable parts attached) will slide easily through the ½-in. hole in the bottom support.

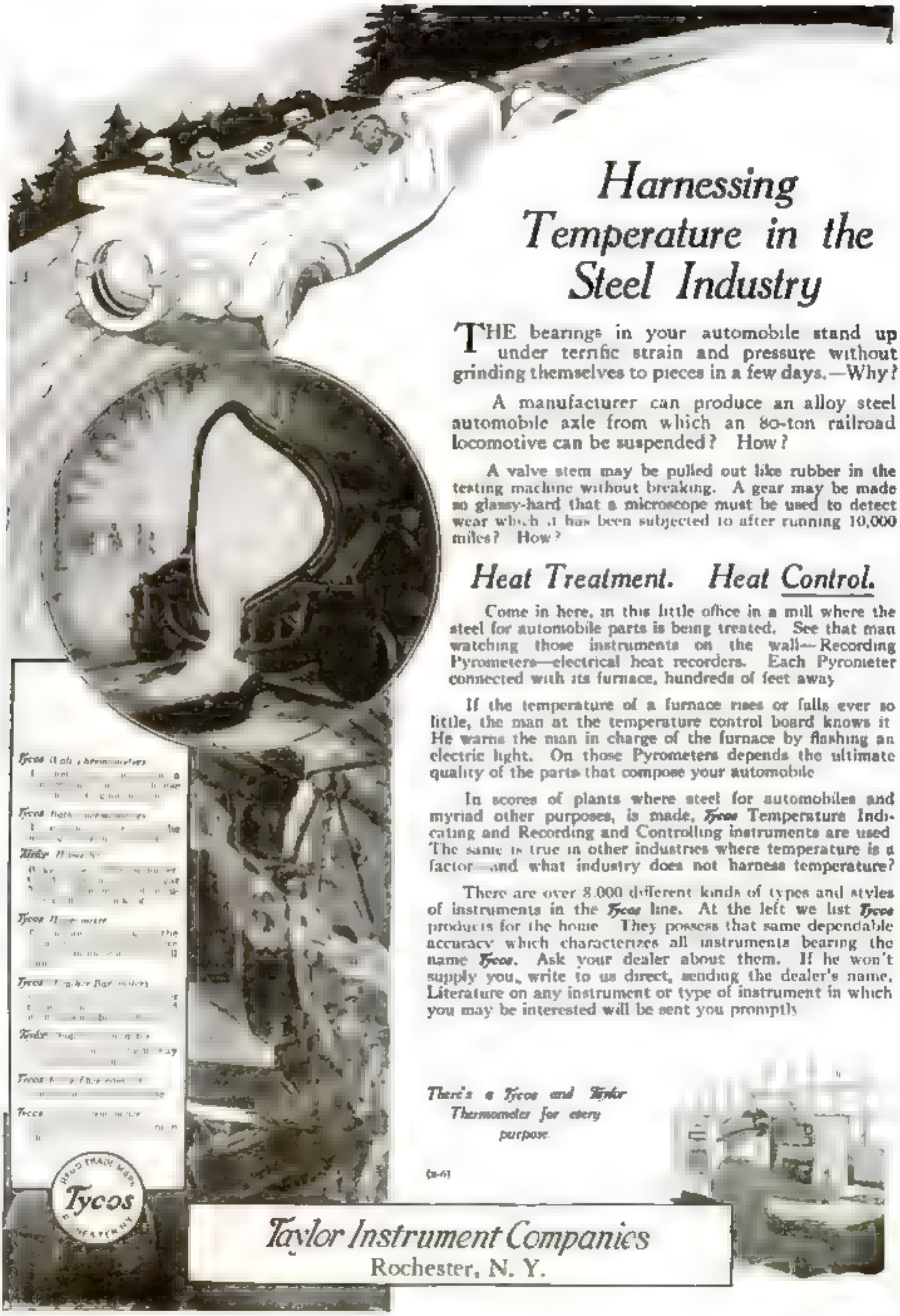
When assembled on the wall, raise the clothes arms to a horizontal position, swing in Part VIII, Fig. 4, until it comes in contact with the ½-in. round rod used for raising, and drilling a small hole so as not to crack the rod, place a screw-eye for this round rod to brace against, thus maintaining the clothes in a horizontal position.

Do not attempt to shellac, varnish, stain, or paint the rack, as the wet clothes would be spoiled. The crudeness of appearance may be improved by using fine sandpaper.

As wash day usually is rainy, your wife or laundress will appreciate your making this rack. If it is rainy or cold outside, it makes no difference, because she can do the wash on schedule and hang the clothes to dry inside.



All parts of the clothes-rack are clearly shown, together with their proper dimensions. The rack is made, preferably, of seasoned ash sandpapered smooth



Harnessing Temperature in the Steel Industry

THE bearings in your automobile stand up under terrific strain and pressure without grinding themselves to pieces in a few days.—Why?

A manufacturer can produce an alloy steel automobile axle from which an 80-ton railroad locomotive can be suspended? How?

A valve stem may be pulled out like rubber in the testing machine without breaking. A gear may be made so glassy-hard that a microscope must be used to detect wear which it has been subjected to after running 10,000 miles? How?

Heat Treatment. Heat Control.

Come in here, in this little office in a mill where the steel for automobile parts is being treated. See that man watching those instruments on the wall—Recording Pyrometers—electrical heat recorders. Each Pyrometer connected with its furnace, hundreds of feet away

If the temperature of a furnace rises or falls ever so little, the man at the temperature control board knows it He warns the man in charge of the furnace by flashing an electric light. On those Pyrometers depends the ultimate quality of the parts that compose your automobile

In scores of plants where steel for automobiles and myriad other purposes, is made, *Tycos* Temperature Indicating and Recording and Controlling instruments are used The same is true in other industries where temperature is a factor—and what industry does not harness temperature?

There are over 8,000 different kinds of types and styles of instruments in the *Tycos* line. At the left we list *Tycos* products for the home They possess that same dependable accuracy which characterizes all instruments bearing the name *Tycos*. Ask your dealer about them. If he won't supply you, write to us direct, sending the dealer's name. Literature on any instrument or type of instrument in which you may be interested will be sent you promptly

There's a Tycos and Taylor Thermometer for every purpose.

(n-6)

Taylor Instrument Companies
Rochester, N. Y.

Make Your Own Electric Toaster

By Edna Purdy

FOR a very small sum an electric toaster can be made at home. Secure a piece of asbestos 6 by 10 in., and ½ in. in thickness. Twelve holes are punched in the asbestos, six at each end, to hold electrician's bolts, which in turn hold six strands of electrical heating wire stretched across the asbestos, held straight in the center by running them through six round-eyed screws. The two electrical wires are connected to the two end screws at one end of the asbestos on the under side. Five small metal strips are placed between the ten remaining screws on the under side of the asbestos to complete the contact of all wires above.

The essential part or heating element of the toaster is now complete. The remaining operations are mostly a matter of choice, except for the underneath finishing, where one must be careful that no metal touches the two wires where they are attached to the outside screws. A suitable stand may be made of sheet metal held ½ in. below the asbestos by hollow posts covering long screws approximately 1¼ in. in length.

The top to hold the toast can be made of heat-proof screening stretched across four straight metal pieces, or heat-proof metal wire may be inserted into the two side metal supports through drilled holes.

Twelve holes are punched in the asbestos to hold the bolts

All points must be protected against short-circuiting

A suitable stand is then made from sheet metal and the heating element attached

Winners of Our $5000 in Scholarships

(Continued from page 77)

Question 8. EDWARD J. VACHUSKA, West Technical High School, Cleveland, Ohio

A grand-stand designer must take into consideration the dead weight of the structure itself, the dead weight of the crowd, force exerted by reaction when dead weight of crowd is put into action in rising or moving and also vibration's effect on material.

The community should require the contractor to make allowance for several times the strain which could possibly be brought to bear on the structure.

Question 9. WILLIAM J. VAN ARTH, High School, Yonkers, New York.

A quick-action ice-cream freezer is simply constructed. A pail with a tight cover is used to hold the ingredients. The cover has a circular hole cut in the top and is made so that a smaller pail may be soldered to it, fitting within the larger pail when the cover is on. A still larger bucket contains both smaller pails and is packed around the inside with ice.

In melting, the ice absorbs the heat from the mixture of ingredients. Salt is used to lower the freezing-point of the ice and water and thus causes it to melt faster.

Question 10. EVERETT P. CARMAN, Central High School, Washington, D. C.

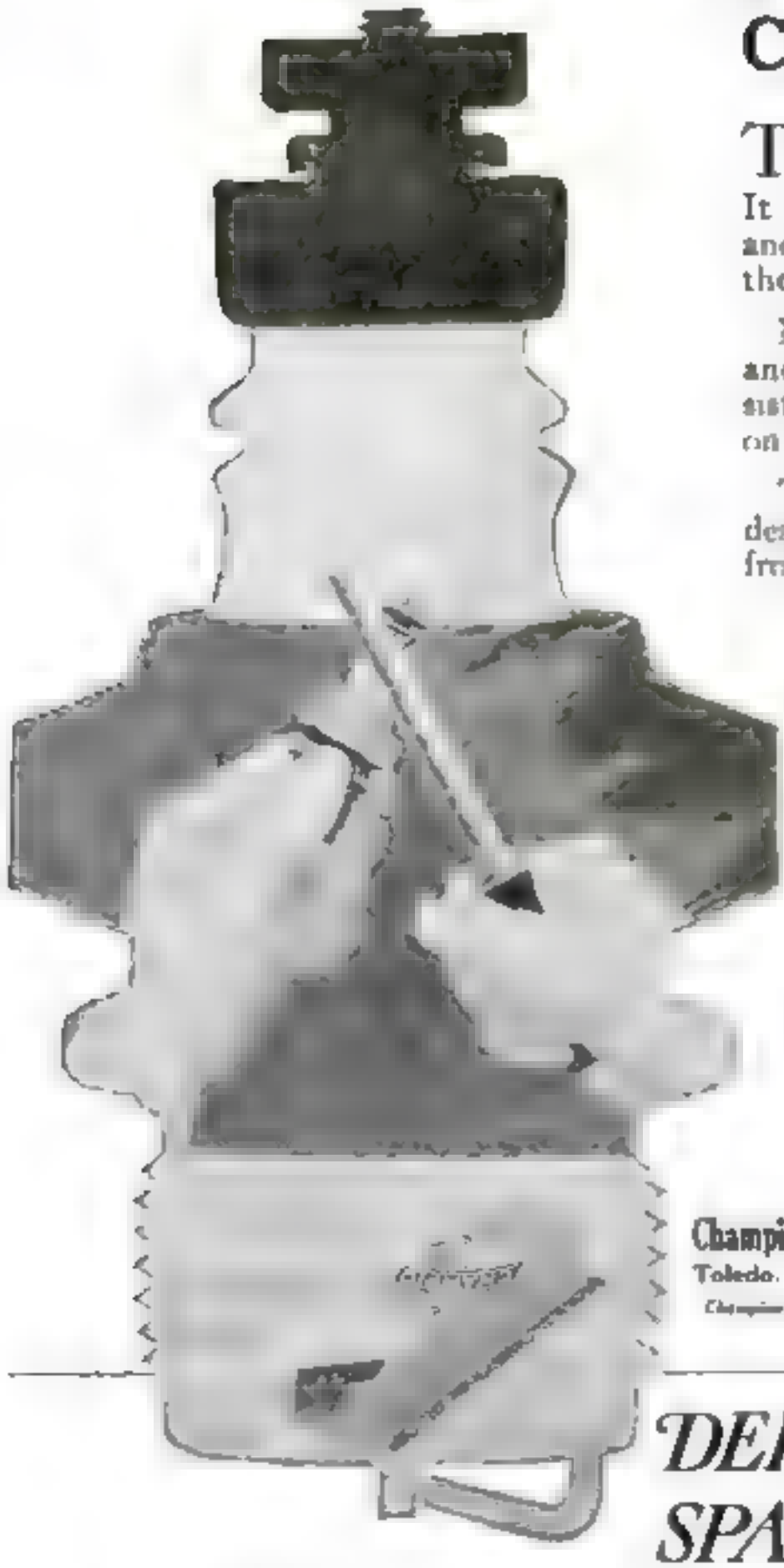
What impressed me most was the fact that the electrician expected the dynamo to stop generating by throwing out the switch at the bus bars. It seems strange that he didn't think of killing the dynamo by throwing out the field switch. I think the helper was a quick chap to catch on so quickly and use in such a time the facts that his chief gave him.

As long as the turbine ran and the electrician did not want that stopped—and as long as there was current in the field coils, the wires of the armature were cutting the lines of force about the field coils and were generating electricity. It was this current which was arcing on the wires in the oil-pit and which was puzzling the head electrician. As soon as the field switch was opened there were no magnetic lines of force about the field coils and the wires of the armature had no magnetic lines to cut, consequently there was not more current generated.

If for any reason the prize-winner in any group is unable to take advantage of the scholarship offer, the student receiving the next highest mark in that group will act as alternate. The names of the second highest students follow:

GEORGE MATHES, Johnson City, Tenn.; JOHN LEWIS, Alexandria, Minn.; SHERWOOD PAUL, Dallas, Tex.; PHILIP HOLGREN, Missoula, Mont.; ROGER HACKNEY, Wellington, Kan.; DOUGLAS W. OWEN, South Bend, Ind.; JAMES M. KUCH, Tarboro, N. C.; F. EDWARD HANDY, Augusta, Maine; SPENCER MEREDITH, Plainfield, N. J.; ALFRED DEXTER BEST, Brooklyn, New York.

Champion



Rough Treatment But Champions Will Stand It

THE famous No. 3450 Insulator in Champion Spark Plugs resists this severe test perfectly. It is your safeguard against the shocks, vibration and temperature changes that constantly attack the spark plugs in your engine.

Most spark plug troubles come from cracked and broken insulators—avoid these troubles by insisting upon the plug with the name "Champion" on the Insulator.

There is a Champion Spark Plug specially designed for every type of engine. Order a set from your dealer today.

Be sure the name Champion is on the Insulator and the World Trade Mark on the Box.

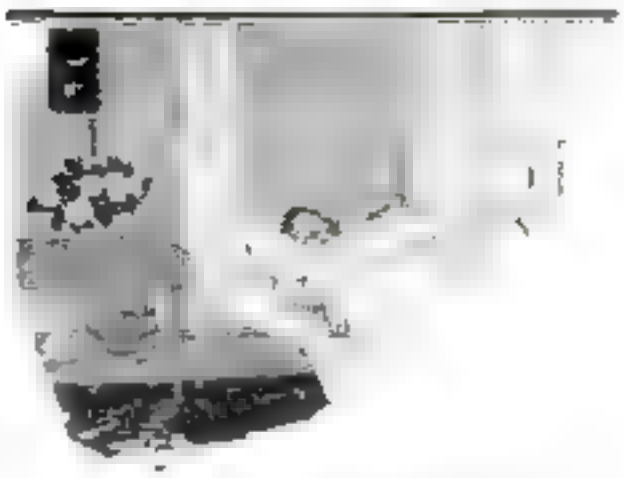
Champion Spark Plug Company
Toledo, Ohio

Champion Spark Plug Company of Ontario, Limited
Windsor, Ontario

DEPENDABLE SPARK PLUGS

An Alarm that Rings by Sound

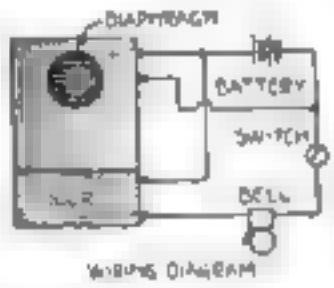
By Windsor Crowell



If set in the sickroom, the instrument will warn those in other rooms that the patient is in need of attention

IT only takes a few simple materials to construct an alarm that will warn the user by a sudden or loud sound operating the mechanism. Such an alarm can be used in various places, such as the sickroom, the nursery, etc., where the noise can warn people in the other part of the house that assistance is needed. There are many other uses to be found for such an idea.

The mechanism is enclosed in a box with a round opening in the front through which the sound is transmitted to the proper part. Make a box of hard wood about 10 in. high, 5 in. wide and 3 in. deep. Leave the front open until all the details are installed and adjusted.



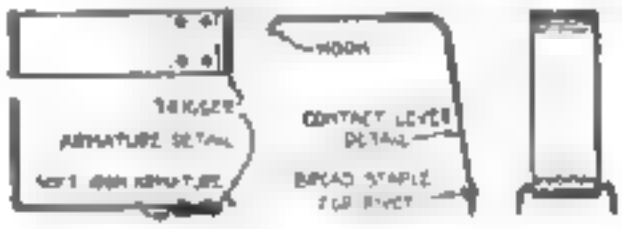
The illustration shows just how the different parts are wired

Near the top fasten a small block of wood about ½ in. thick. Then procure a disk of metal similar to the diaphragm of a telephone receiver, 3 in. in diameter, and fasten the top edge to the block with one screw. Set a second screw into the back of the box directly under the lower edge of the diaphragm and adjust the head so it clears the diaphragm by just the merest fraction of an inch.

In the center of the bottom set a magnet. One taken from an old telegraph or electric bell will suffice. A pair of them will do as well as one. Connect the magnet to the diaphragm as shown, one terminal to the contact screw under the diaphragm, the other terminal to binding-post *B*. The screw holding diaphragm to the block is connected to binding-post *A*.

The armature consists of a piece of spring brass 1 in. wide, bent at right angles as shown. The long arm is bent at the end in the form of a "trigger." Underneath the metal next the trigger is riveted a piece of soft iron. The short arm of this brass strip is drilled with two holes by which it is fastened to the side of the box. When in position the iron armature should rest about 3/16 in. over the pole of the magnet. The brass should be stiff enough to retain its position, but not too stiff to prevent the magnet pulling it down when electrified.

The contact lever is shown in detail and consists of a stiff metal arm bent as shown. The end of the horizontal member is bent down in a hook which fits over the trigger of the armature. Roll up the bottom end over the horizontal shank of a wide staple which is driven into the bottom of the box near the corner. This acts as a pivot for the lever to swing on. Near the angle of the lever drill a small hole into which put a very light spiral spring. Fasten the opposite end of the spring to the side of the box and adjust the tension so that when the hook slips off the trigger the lever will be pulled back into good contact with binding-post *C*. The pivoted end of the lever should be wired to binding-post *D*. Binding-post *C* should be arranged so it can be adjusted in or out and contact changed as necessary. A cover should then be made for the box with a round opening over the diaphragm. Near the bottom arrange a small door which will drop down and allow the contact lever to be set in place when the apparatus is to be used.



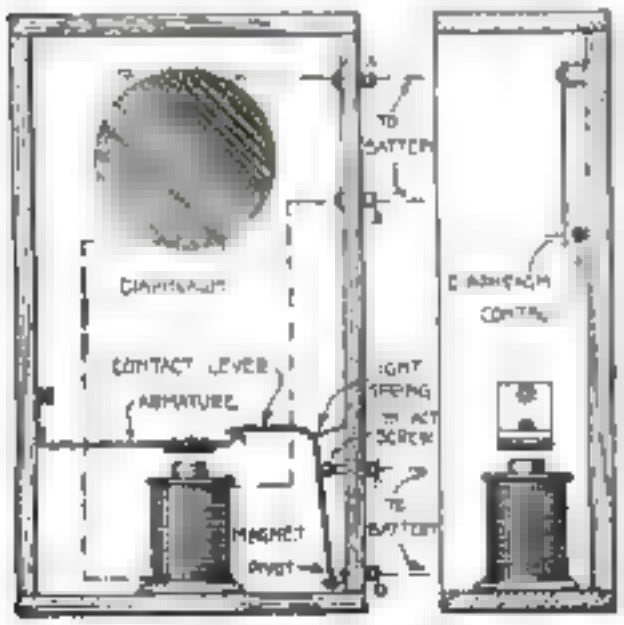
The parts necessary to the proper operation of the device are shown herewith

Connect binding-posts *A* and *B* to a battery as indicated. Then connect binding-posts *C* and *D* to the same battery and a bell with a switch in the line.

The action is as follows: With the contact lever hooked over the armature and the bell switch on, let some one speak or make a sharp sound in front of the opening. The diaphragm will vibrate and make contact with the screw beneath it. This energizes the magnet, which pulls the armature down to it and releases the contact lever. The spring pulls this back and makes a fixed contact with binding-post *C*, which in turn rings the bell. In the meantime the diaphragm has stopped vibrating and the armature returns to its original position.

The bell will ring until the switch is opened and the circuit cut off. The contact lever can then be reset for the next alarm.

This apparatus is simple to construct and will be found to be useful.



The mechanism is enclosed in a box with a round opening in the front

How to Break Up Cement Posts

By E. L. Harvey

CEMENT is a mighty tenacious material, as any one who has been obliged to dispose of cement walls, posts, or other structures made of the substance can testify. It is that very tenacity that makes it valuable and so highly appreciated as a building material. Still, occasions arise when it becomes necessary to break up something made of cement. That means trouble and hard work unless one happens to know how to go about it.

For the benefit of those who may have similar work to do, I want to describe how I disposed of some cement posts which were 5 ft. high, 28 in. wide at the top and 3 ft. wide at the bottom, located inside of a building, and within 30 ft. of 1080 panes of glass. My method was so successful that I didn't break a single pane of this glass. I drilled a hole 6 in. deep about 1½ ft. from the top of each post, another hole 18 in. lower about 10 in. deep, and at the bottom two very shallow holes on opposite sides. In each of these holes, I loaded a third of a cartridge of 40 per cent strength dynamite.

The charges were primed with electric blasting-caps and connected up to a blasting-machine circuit.

Before firing, the posts were covered with old blankets and pieces of burlap, on top of which were laid heavy strips of timber. The shots broke up the posts very nicely. The cost of explosive for each post was about 11 cents for the dynamite and 16 cents for the electric blasting-caps.

I have no doubt that any farmer who has spent the better part of the day breaking up cement structures with a sledge-hammer will be glad to know of this easy way of saving time and labor.

Blue Buckle OverAlls

Union Made

AS quick as you get into Blue Buckle OverAlls and Coats you know why they're the biggest selling work togs in America. You get the strength of the sturdy indigo-blue denim, the Union workmanship so hardy against wear.

Go over the Blue Buckle features! The tack-stitched pockets and seams, fly cut *into* the garment, comfortable, elastic stay-up suspenders—these and many other details absolutely insure more comfort and more wear.

Invest in Blue Buckles for comfort and economy. Get your pair today.

Ask your dealer for Blue Buckles

Jobbers OverAll Co., Inc., Lynchburg, Va.

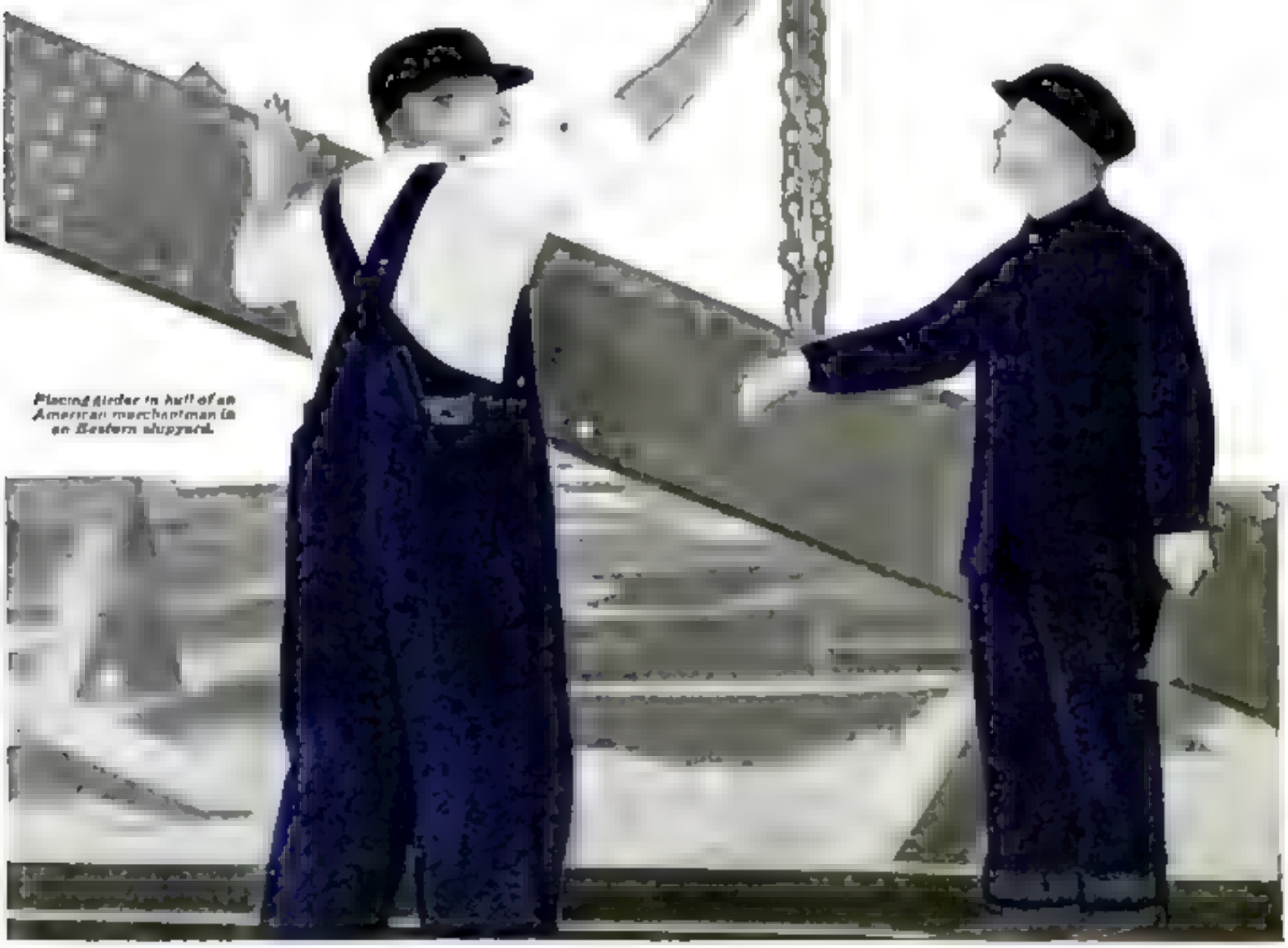
Largest manufacturers of overalls in the world

***Blue Buckle* "Buddies"**

for children 4 to 16 years duplicate the men's garments in quality, pattern and workmanship. They're the best wearing play-garments sold in America.

"Strong for Work"

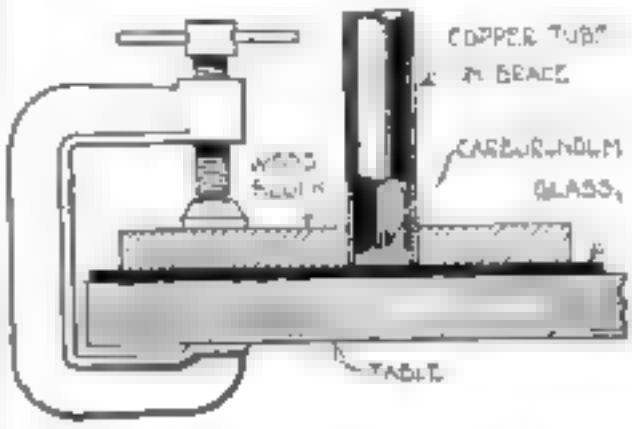
This ticket appears on every pair of the biggest selling overalls in the world.



Placing girder in hull of an American merchantman in an Eastern shipyard.

The Way to Cut Large Holes in Glass

IT is surprisingly easy to cut large holes in glass. For a drill use a copper tube the size of the hole required, make the end square and true and put it in an ordinary brace. For a cutting medium use a mixture of turpentine and fine carborundum and keep the drill well supplied. Apply



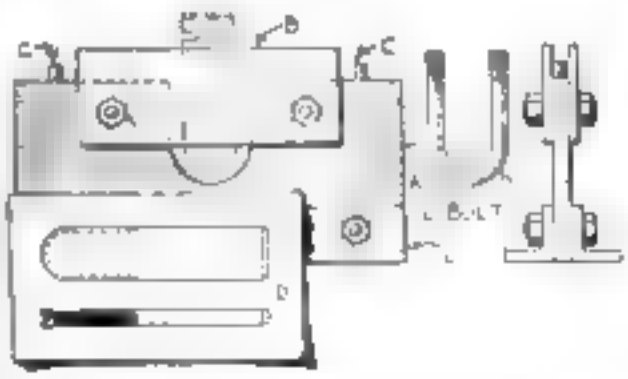
Large holes can be drilled in glass with a copper tube for a drill and carborundum used as a cutting medium

just enough pressure so you can feel the carborundum cutting. Go slowly and carefully when nearly through, if you want to make a clean hole. To start the hole in the right place, clamp over the glass a piece of wood with a hole in it just large enough for the tube to pass through. This need be used only until the drill has cut far enough so it will require no further guiding.

Bending U-Bolts with a Homemade Tool

THE illustration shows a tool that was constructed to bend U-bolts which were threaded at both ends and taken hot from the fire.

The body, *A*, is made from a piece of flat bar steel, a little wider than the U-bolt and was cut out on the top side the desired shape of the formed bolt. Two plates, *B*, bolted to the



If you have U bolts to bend, here is the tool to do it quickly and neatly

sides, and with the pins, *C*, held the red-hot rod in position, while with the forming bar, *D*, it was forced into the U shape with a few strokes of a hammer. The forming bar was grooved to fit the bolt.

The two angles, *E*, were bolted at the under side of the flat steel bar, as shown, to hold it in an upright position. With this form the two hundred bolts were bent true and all alike in a very short time.—E. S. GOODELL.

Who Stands Behind *your* Tires

OUT of all the different kinds of tires in the bicycle shop, how is anyone to tell which kind is best? There must be some way of telling—and as good a way as any is to look at the *reputation* of the companies behind them. The makers of U. S. Bicycle Tires are the *oldest* and *largest* rubber manufacturers in the world—and you can invest your last nickel on the fact that *there is a reason for it* other than merely the number and size of their factories.

U. S. Chain Treads, U. S. Cords and seven other treads in Clincher and Single tube styles.

"Ride a Bicycle"

United States Tires

United States Rubber Company

Monogramming Your Own Automobile

By L. B. Robbins

A PRIVATE monogram or display of the owner's initials upon the doors of his automobile always adds class and distinction. But it generally is thought that to work out a monogram is the job for an artist or professional painter and is beyond the ability of the amateur. Of course the design may be an impossibility for the owner to create, but with the aid of an artistic friend, the proper arrangement of letters can be accomplished. Then it is only the matter of applying those letters to the car-doors in the right way.

The paper stencil is laid against the car and the paint-brush is passed swiftly over it

Now there are several ways to apply designs, but the easiest and simplest for the amateur is by means of the stencil. It is an easy trick, once you know how, and is worth trying, especially if you can save money and have a good-looking job in the end.

First draw your design upon rough paper until a pleasing arrangement is produced. For the small car I would make the complete height of the design not over 1¼ in., but for the large car one can stand a height of 2 in. The width depends upon the nature of the letters and their relation to each other when interwoven, but try and have the design as nearly square as possible.

If a simple row of initials is desired instead of the monogram, it is better to have them somewhat smaller than in the monogram; that is, shorter, say about ¾ in. for the small car to 1¼ in. for the larger car. All this, of course, must be left entirely to the artistic instinct of yourself or your friend.

With the design completed comes the cutting of the stencil. First transfer the drawing to a piece of heavy, stiff manila paper by means of carbon paper. Lay the drawing over the manila with a piece of carbon between, face down, and trace over the lines of the drawing with a hard-pointed pencil.

Then comes the cutting. This requires great care as it takes a sharp knife and a steady hand. Lay the stencil paper upon a piece of glass, holding two sides down with the left hand. Then cut carefully along the lines of the design with the point of a sharp penknife blade or a regular stencil knife. Whet the blade occasionally so the edge will not chip and drag the edge of the cut, making a ragged tear. Much depends upon a good clean-cut stencil.

Allow Plenty of Margin

As will be noticed in the illustration, each letter is connected to the next with "binders." Their purpose is obvious. All parts that would have no support in the design otherwise should be connected to each other in this manner. Allow plenty of margin to handle the stencil by. If, in the course of continued use, any of these binders becomes broken or torn, it can be mended with court-plaster.

After the design is cut, give the paper one or two coats of shellac or varnish on each side. This renders it impervious to oil or water.

Now determine the exact spot on the car-door that you wish the monogram and, without marring the finish, draw an outline of the size of the design and then rub carefully and smoothly over the varnish with an ink-eraser. This will remove the gloss and leave a dull finish but will not cut through to the metal of the door underneath.

To prepare a suitable paint for the stenciling, take a tube of artist's paint of the desired color and squeeze a little out on a blotter so as to absorb all the oil possible from the paint. Then remove to a piece of glass with a knife-blade and mix the resulting solid pigment with just enough gasoline to make a creamy paste. Use a color which will contrast well with the color of your car. If a gold monogram is desired, use a varnish body for stenciling and paint over it with the gold paint later. With the paint prepared, apply the design to the car

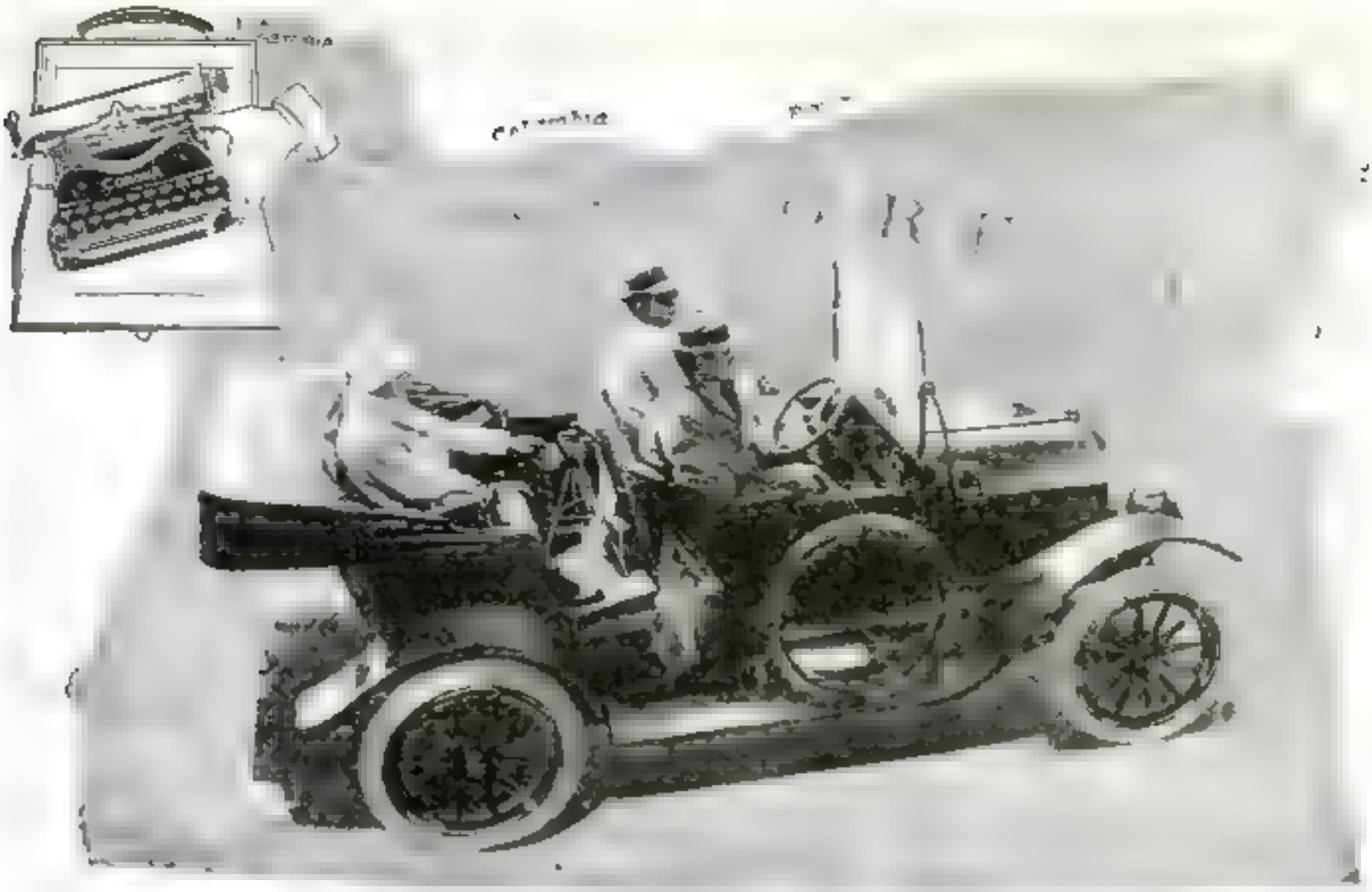
A Flat Brush with Stiff Bristles

Hold the stencil against the car over the roughened spot with the left hand. Spread the fingers so as to apply as firmly as possible all around the edges of the paper. Then dip the brush in the prepared color and wipe off the surplus on a cloth. Hold it in the right hand well down toward the bristles and rub briskly back and forth across the design until all the spaces are filled. Use a stiff-bristled brush with a flat edge. Be careful not to allow any of the color to creep under the edges of the stencil as that will only have to be wiped away later.

With this done, pull the stencil away from the surface, being careful not to slide in a sidewise direction.

The last process is to fill in the spaces left by the binders and go over the whole design a second and perhaps a third time. This is best done with the use of a mahl-stick. One can be made by wrapping one end of a stick with cloth and resting this covered end on the top of the door. Then, by holding the other end in the left hand, the stick can be used as a rest for the right arm or wrist. This steadies the hand filling in the letters. Use an artist's pointed brush for the final filling in and a rather free-flowing paint containing dryer. Do not have it too free, however, so that it will run down over the edges of the letters.

Hold the hand well down near the brush bristles and rub briskly back and forth



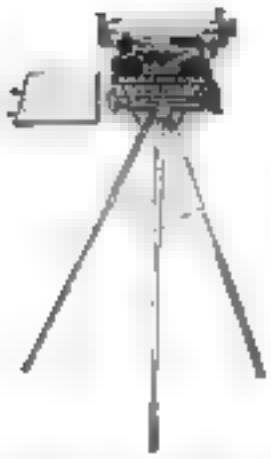
"—and they Coronatyped all over Oregon!"

IN 1917 Corona recorded a 1400 mile motor journey of E. T. Buzzelle, of Salem, Oregon, whose job was to make a property inventory for the Washington-Oregon Telephone Company. The trip was accomplished through all kinds of weather and over all sorts of roads, and Mr. Buzzelle kept on typing, often when the car made 30 miles an hour. Despite a coating of sand and dust, Corona finished in excellent condition.

Your Corona may never be subjected to so severe a test; but it is interesting to know that its lightness and compactness have been achieved while still retaining full measure of staunchness and "write-ability."

Price $50 with carrying case.

Consult your telephone book for name of nearest Corona dealer.



A Telescoping Tripod Stand

Made of seamless brass tubing, finely nickeled. Provided with copyholder. Adjustable to three different heights, 19½ inches long when folded. Convenient anywhere, especially when out-door or traveling. Price, $6.00.

Built by
CORONA TYPEWRITER COMPANY, Inc.
GROTON N. Y.

CORONA

The Personal Writing Machine

TRADE MARK

Fold it up—Take it with you—Typewrite anywhere

After the final coat is bone-dry, go over the design with a coat of thin automobile varnish as far as the edges of the roughened part. If carefully done, the meeting of the old and new varnish will be hardly perceptible.

In the case of gold paint, use a varnish base. Then when that is dry, apply the gold thinned in lacquer. Then varnish as before.

Of course the design may be embellished with fine hair lines, etc., around the edges of the letters, stripes down the middle of the letters or letters of various colors.

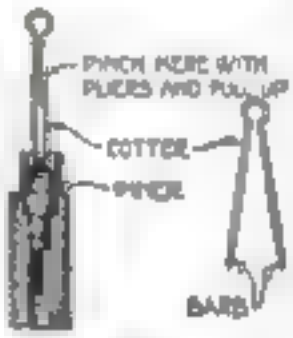
After using the stencil, be sure and wipe all traces of paint from the edges and sides before applying to the other door.

With a little practice perhaps you will become expert enough to make monogramming a side line.

How to Remove Obstinate Valve-Stems

DID you ever wrestle with a tire valve-stem that had become stuck below the top of the valve? They are obstinate things, but here is a simple way to remove them:

Take a large cotter-pin that will fit easily inside the valve and file two or three little barbs inside of each end of the tines.



Showing how to remove a valve-stem quickly

Then, by inserting the pin into the valve and spreading the tines over the end of the stem, it can be removed by squeezing the parts of the pin together with a pair of pliers and pulling up smartly. The barbs grip the inner top and hold it while the pull is being exerted.—WINDSOR CROWELL.

A Substitute for a Lost Collar Button

IT is foolish to ask if you have ever lost your collar button. You have, of course; every one has. The next time you lose it, make an emergency one from shirt buttons.

Take two shirt buttons, one a little smaller than the other, and sew them together as shown in the illustration, leaving about ⅛ in. of space between them. Then make a few turns of the formation of thread strands between the buttons to reinforce them and your emergency button is complete.

A collar button made from two shirt buttons is an excellent substitute

This button is worn just as the metal one is worn, and it will be found to take up less space in the collar band of your shirt.—C. D. ZELLAR.

The Hands of a Nation

OVER half of the working hands of the nation are doing their daily tasks in Boss Work Gloves.

They are a sure protection against dirt, dust, grease, paint and many minor injuries.

They are heavy enough to wear well, yet light and flexible enough to allow you to "feel" your work. They are easy to slip in-to and out-of.

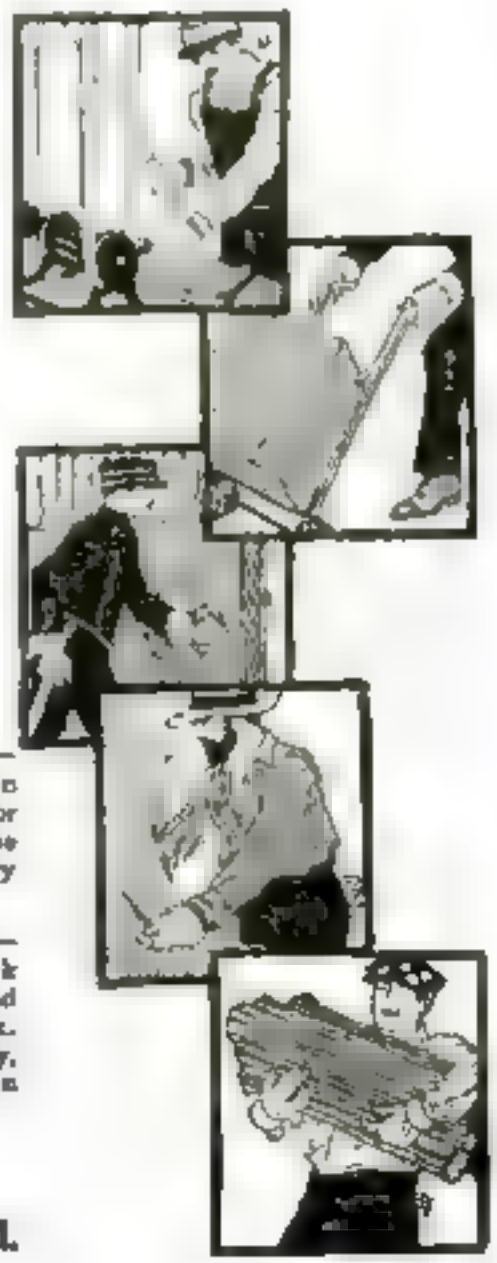
Thousands of painters, ironworkers, gardeners, blacksmiths and farmers swear by Boss Work Gloves.

Workers in hundreds of different lines of trade wear them every day. Women find scores of uses for them about the house.

They are supreme on the hands of the Nation.

Everyone should keep a pair around home, in the automobile, at the office or the shop. Slip them on whenever hand work is to be done. Priced so low that you can afford a new pair every day if necessary.

Ask your dealer for Boss Gloves. Sizes for men and women, boys and girls. Three styles of wrist, band, ribbed, and gauntlet. One of these popular models will be just what you need.



***THE BOSS* MEEDY**—The world's favorite work glove for odd jobs around the house and garden, and all light hand-work. Made of the best quality, medium weight canton flannel.

***THE BOSS* HEVY**—The best bet for all work that requires a strong, wear-resisting glove. Made of the very best quality, heavy weight canton flannel.

***THE BOSS* XTRA HEVY**—The world's champion heavyweight handwear for rough work. Made of the finest grade of extra heavy canton flannel.

***THE BOSS* WALLOPER**—This is the super work glove. Strong, flexible and built for rugged work. Made of the highest quality, heaviest weight canton flannel.

The Boss line includes highest quality leather-palm, jersey, ticking, and canton flannel gloves and mittens.

This Trade-mark identifies genuine Boss Work Gloves. Be sure it is on every pair you buy.

Boss

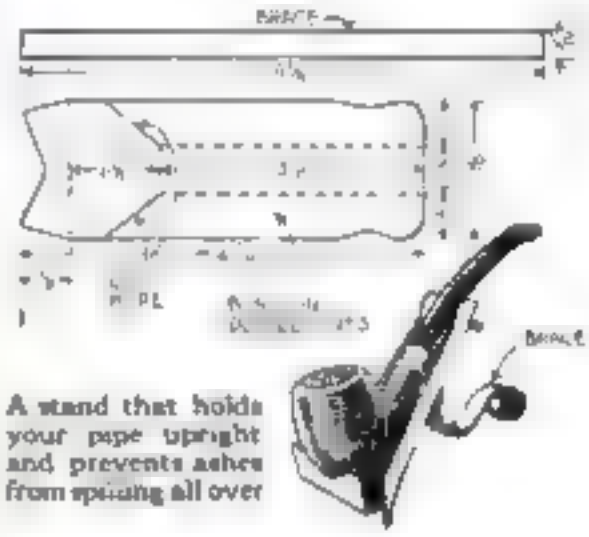
Trade Mark

THE BOSS MANUFACTURING CO., Kewanee, Ill.

A Stand that Will Hold Pipes Upright

EVERY pipe-smoker knows that the instant he lays down his pipe it tips over and spills ashes. Naturally it is impossible for friend wife to keep the house clean when this is the case, for the minute she sweeps up the ashes, more are deposited. Then, too, these hot ashes either burn holes in the table-covering or carpet, or cause the varnish to turn black.

To prevent this nuisance, a neat and decorative little pipe-stand may easily



A stand that holds your pipe upright and prevents ashes from spilling all over

be made from a thin sheet of copper or brass. The pattern is carefully scratched in with a scriber or steel point and then cut with a hacksaw, bent over into shape on the edge of a table, or other hard surface.

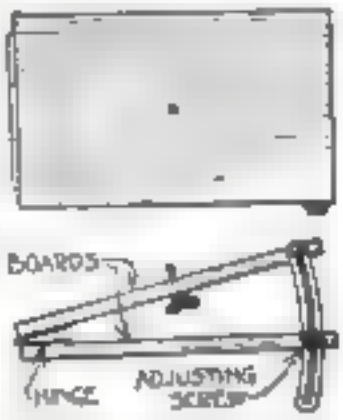
All dimensions are given in the illustration, which needs no other description. The back of the stand is soldered to the front after the parts are made.

The metal is then cleaned with emery cloth and polished and varnished to prevent it from tarnishing.

When You Take Pictures at an Angle

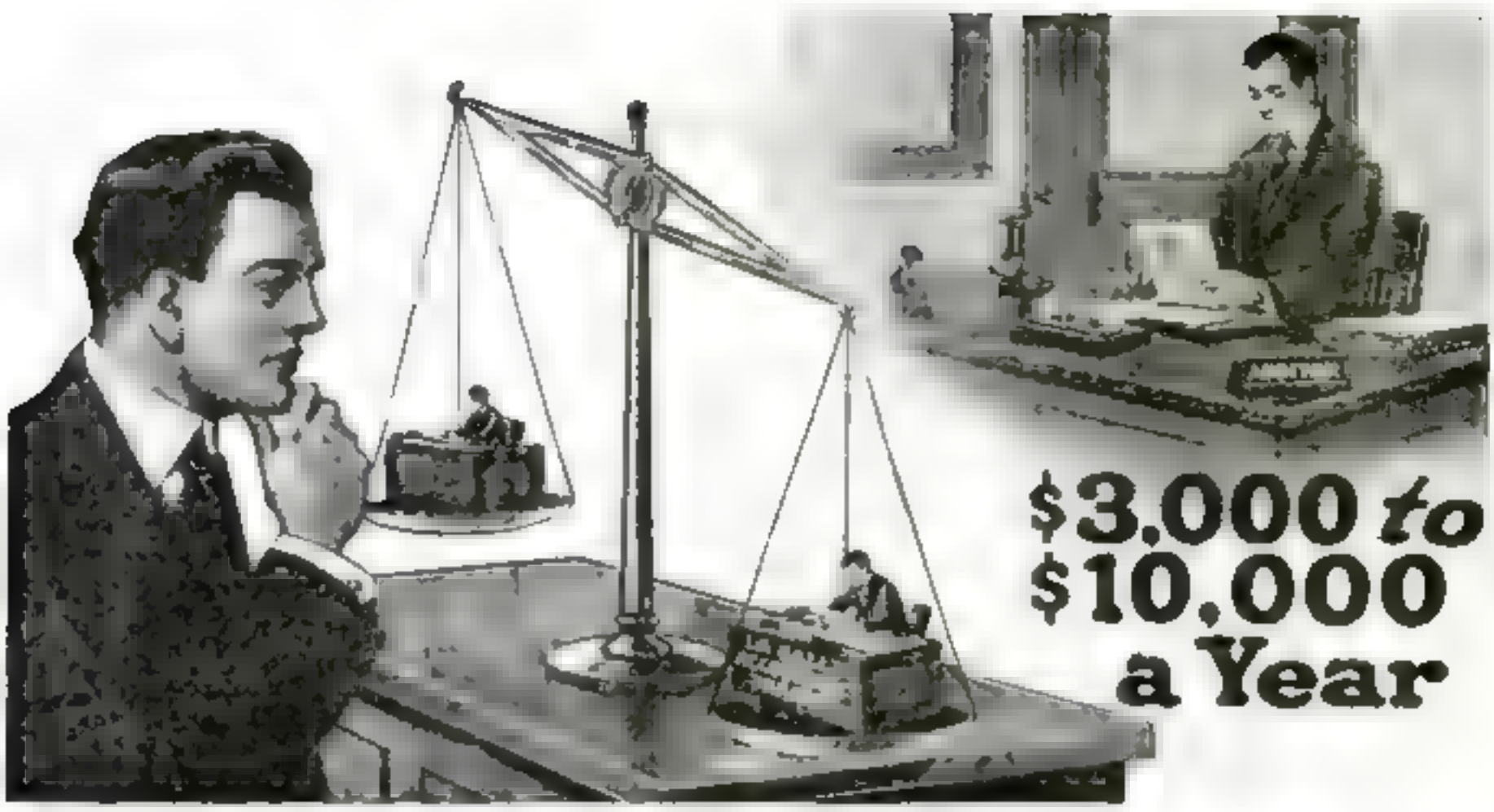
IN order to take pictures at an angle, a convenient tripod arrangement can easily be made. It consists of two thin boards, from ⅜ to ¼ in. thick, fastened together at one end by a hinge.

The center of each board has a small hole. Into the lower hole a nut is countersunk so that the board can be tightly screwed to the tripod plate. The other hole receives a winged box with which the camera is fastened to the support. At the farther end of the upper board a thick stiff wire is attached so as to be movable.



Fasten two thin boards together with a hinge and take pictures at any angle

The lower extremity of the wire ends in a long loop which fits into a nut and bolt arrangement so that the camera can be tilted and locked at any angle.



The Accountancy Trained Man Wins!

EVERY ambitious man strives for three things: First, promotion; second, increased salary; third, larger business success.

In the race for these things the man thoroly trained in Higher Accountancy by the LaSalle Problem Method has a tremendous advantage over the untrained man. It has enabled thousands of ambitious men to step from ordinary jobs into important positions with high salaries.

The Accountancy expert is capable of improving his employer's system of bookkeeping and cost accounting. He is able to warn his firm of approaching dangers from increased costs and decreased profit. He knows every minute just where each department stands in relation to production cost and profit.

Such training in Higher Accountancy as is offered by the LaSalle Problem Method of home-training can easily be completed in your spare time without interference with your present position. Why should it not produce the same results for you as it has for the men whose letters appear below?

"As a result of LaSalle's training in Higher Accountancy I increased my salary 33½ per cent within eleven months from date of enrolment." W. R.

"I am now auditor of this company. While I have not yet fully completed the course my salary has been increased 600 per cent, all as a result of your training." G. W. A.

"Before I decided to take up this course I was receiving an ordinary bookkeeper's salary. I am now a director and secretary of the company." W. M.

"I am now a Certified Public Accountant and have been connected with an Atlanta firm of accountants for the past year. My earnings have increased over 300 per cent." W. W. D.

Today business does not pick men for advancement for any other reason than that they have acquired specialized knowledge and training which fits them for important duties. Specialized accountancy knowledge and training are now available to every ambitious man through the home-training course of LaSalle Extension University.

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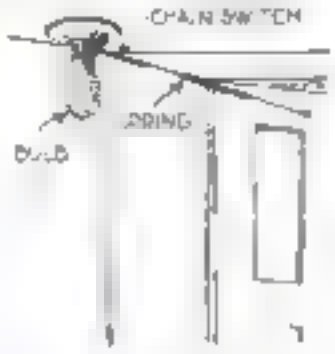
Opening the Door Turns On the Light

THE electric light in a storeroom was made to turn on automatically when the door was opened by simply connecting it as shown in the illustration.

Being of the pull-chain type of light socket, the two movements required to turn it on and off were alike.



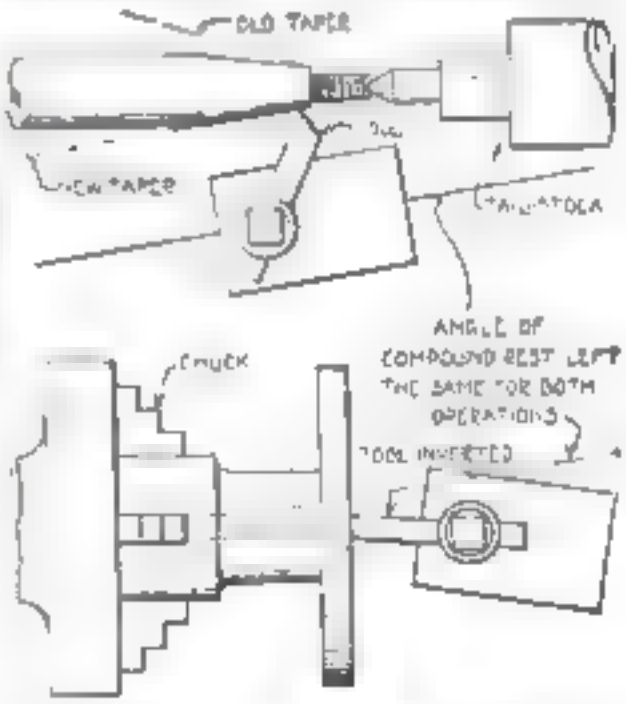
Make the door operate the light switch automatically

The chain was connected to one end of a screen-door spring by a stout cord. The other end of the spring was then connected to another length of cord, which was fastened to the door, as can be seen above.

The spring prevented damage to the switch, and when the door was opened the light was automatically turned on. Then, as the door was opened again when the occupant left, it was switched off.

A Way to Replace Your Magneto Couplings

A SIMPLE way of replacing a coupling and magneto when the taper is worn is to true up the taper by using the compound rest on a lathe (not by moving the tailstock). Set the compound rest so that it will turn the new taper as shown in the illustration. After the taper has been turned on the magneto shaft, do not move the



The taper on a magneto coupling may be easily trued up by setting it in a lathe

compound rest, but leave it at that setting.

Put on the chuck, and turn up a new flange coupling, finishing it all but the taper. Then turn the boring tool upside down and run the lathe the same way as before, the tool cutting at the back instead of the front. The taper must be the same and the coupling will then fit perfectly.

The Simplest Drill-Press that Can Be Made

HERE is the simplest thing there is in the way of a drill-press. Use the ordinary hand-drill for the "business" part of the apparatus, and secure it to a board. The exact method of securing it will depend largely upon the construction of the drill, but for one which has a handle in the frame, this can be unscrewed and a machine-screw of the right size and thread put

An ordinary hand-drill and a wooden frame will make the simplest possible drill-press that does excellent work

through the board and into the frame of the drill, in addition to which there must be another fastening to keep the tool in line.

For the feeding mechanism, use a steel rod or a piece of tubing—substantial brass tubing will answer—and arrange it to slide up and down in brackets under the drill-press, taking care that the rod is in line with the shaft of the drill. A little table on the top of the rod holds the work, which may be secured by means of an ordinary clamp. A lever acting on the lower end of the sliding rod serves as a feed, and is hung on a leather strip. As the holes drilled are rarely of any great depth, the tool can be arranged so that the operator sits in front of it and operates the feed lever with his knee, leaving both hands free.

Another way in which the same principle can be applied is to rig a similar apparatus, but on a somewhat larger scale, using an ordinary brace and bit instead of the hand-drill. Some braces cannot be used in this way. The best for the purpose is the cheap kind without ratchet. This is surprisingly convenient in many cases, and it has the advantage that it will bore long, straight holes with very little trouble and, by using a fairly long lever, as much pressure may be applied as is necessary for large bits.

Making a Useful Bathtub Drain-Cleaner

BATHTUB drain-pipes will get clogged up at times and prove very difficult to clear on account of the small diameter of the discharge pipe. After working over three hours with a plumber's rubber suction pump, that failed to remove the deposit, the writer made the device shown in the illustration that did the work in less than two minutes.

Obtain from a hardware store a tapered rubber plug measuring 1½ in. wide across the top and 1¼ in. wide at the bottom. The plug as bought will be found to have a rubber ridge on top, to which is fastened a nickel-plated lifting-ring. Cut the ridge off level with top and bore a hole in the center a trifle smaller than the outside

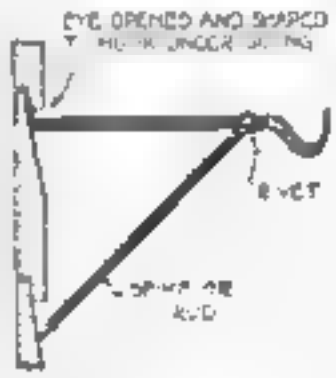
Don't call the plumber when the drain-pipe clogs, for you can make a device which will free it of any deposit

diameter of a short section of ½-in. iron pipe, the latter to have a length of 3 in. and be threaded for all its length, or partly so, as preferred. Run a coupling on threads of pipe, then screw the latter through the rubber plug, after which place a locknut on the end of pipe to hold plug in place. Put the coupling close to the plug so as to grip it tightly. Place plug in place in tub and measure the distance from coupling pipe end to the shoulder on the double faucets, allowing it to be a little longer than is necessary. Then buy the required length of red rubber tubing of ½ in. inside diameter to fit the pipe near coupling, fastening the tubing tightly with wire, and the job is done.

To use, put the tube end on faucets first, as far as it will go, then put the plug in place. If the tubing has the right length, it will be straight, and owing to its slight extra length, from the measured dimensions, it will exert a thrust against the bottom of tub and stay in position against a water pressure of 90 lbs. or less; thus obviating the necessity of holding it in position while in use. When bought, the tubing will be found to be curved—and it will remain so—but this is an advantage, as it helps the cleaner to stay in place while in action.

A Paint-Pail Bracket from an Old Door-Hook

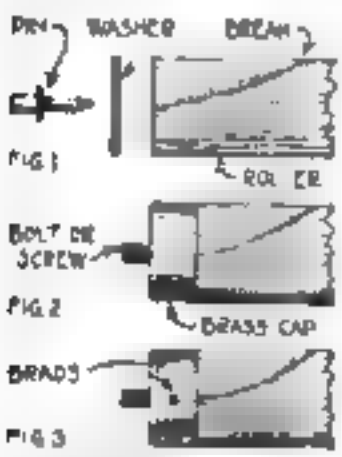
HERE is how a paint-pail bracket was devised from an old door-hook. This painter was a crank on hooks and declared that he would quit the job unless he was provided with a paint-pail hook of some sort. When it looked as though the wielder of the brush would pull his stakes and depart, the handy man of the place hove into view with a hook made from an old 6-in. door-hook. The eye which originally accommodated the staple was straightened out and flattened in the manner shown above. Likewise a 20-penny spike was flattened at one end after the head had been removed, and a hole was drilled through it. A similar hole was drilled through the square door-hook about 1 in. from the end, as shown, and the two held together with a rivet. All that was necessary then was to bend up ½ in. of the flattened end, which, when in use, slips under the edge of one of the clapboards or sheets of siding. The point of the spike is set to bear against the side of the building lower down, to bring the hook out at right angles to the building, and the paint-pail is hung on the outer end as shown.—DALE VAN HORN.



Why reach down for the paint-pail when you can make this bracket?

To Repair a Curtain-Roller that Has Split

WHEN cutting a wooden curtain-roller to an undersized window, it sometimes happens that the grain of the wood runs very much on the bias. Driving a stout pin into it may cause a portion of the roller to split off, as in Fig. 1.

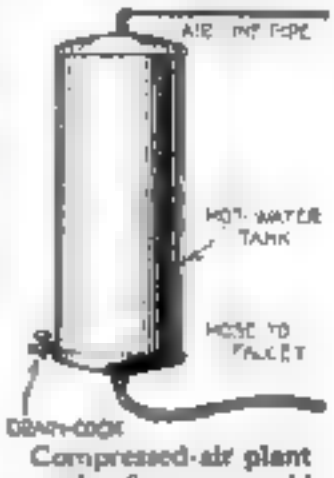


An improvised roller cap can be made from an old battery terminal end

A good preventive for this fault is to use the brass cap from an old dry-battery carbon. The cap is provided with a screw which answers the purpose of the pin (Fig. 2). Break the battery carbon off level with the rim of the cap and crack it in pieces, then remove the pieces. Set the cap on the end of the roller and secure it with brads as shown in Fig. 3. Should the split occur despite your care in cutting it down, the wooden parts may be glued and then secured as described.

Making an Air-Compressor of an Old Boiler

WHERE a steady supply of air at pressure is required, it can be obtained by using an old water-tank, such as is used for hot water, and connecting the tank with the water supply in any convenient way. The idea is to allow water to run into the tank, thereby compressing the air in it, and piping the air to the blowpipe or other work from the top.



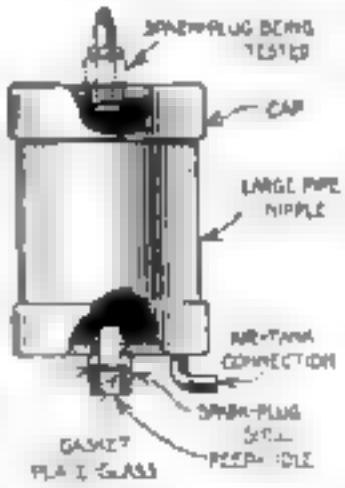
Compressed-air plant made from an old kitchen boiler

When the tank becomes full, the water is drained off; but where the volume of air required is not great, a very considerable amount of work can be done on one filling of water.

It will facilitate matters and economize water and time if the tank is first pumped up to working pressure with an ordinary foot-pump connected to the air outlet. After that, any desired pressure can be obtained by regulating the flow of water. If the tank is old and leaky, it can be made serviceable by coating the inside with tar, heating the tank in order to keep the tar liquid long enough so the tank can be rolled around to carry the tar to all parts. Drain out the surplus through the openings. Needless to say, all valves must be removed while this is being done.

A Spark-Plug Tester for the Use of Garagemen

IT is difficult to determine the condition of a spark-plug, unless the plug can be subjected to pressure, for under atmospheric pressure a spark will leap across the electrode gap, even if the porcelain or mica is broken down. For this reason, every garage or repair-shop should have a compression tester, a device in which the plug may be placed and subjected to a pressure of from 60 to 75 lbs. a sq in., then connected with a coil and the action of the spark noted.



This spark-plug tester will detect defects immediately

To make such a testing-box obtain a 4-in. iron pipe nipple, about 6 in. in length, and fit it with two pipe caps. In one of the pipe caps drill and tap a hole large enough to receive the spark-plug. Usually two testers will be necessary,

one for ½-in. plugs, the other for ¾-in. plugs, since these two sizes are most common.

In the other end drill two holes; a small one, about ⅛-in. pipe-thread size, the other for a ¾-in. spark-plug. The smaller hole is for connection with the compressed-air tank, or a tire pump, while the larger, which should be in the center, is to be fitted with a second spark-plug, especially prepared.

This latter spark-plug is to be used as a window, so the porcelain must be removed and a round piece of plate-glass substituted.

A Simple Tire-Remover for Split Rims

ANY ONE who pulls and tugs on a split rim in an endeavor to remove the tire is as foolish as the fellow who tries to blow up a tire with his mouth and lungs. It is an easy matter for any one to make a split-rim contracting-tool that will do the work without wasting one's strength.

The essential parts are three chains, three hooks, and a twisting-post. The latter may be made from a piece of 2-in. iron pipe, about 6 in. in length. Each of the three chains is fitted with a hook which is bent to fit over

The pipe revolving upon the chains and clamps easily pulls out the split rim far enough for it to be removed

the edge of the rim. The other ends of the chains are fastened to the pipe and spaced 120° apart, as shown in the sketch.

Two holes are drilled in the 2-in. pipe at opposite sides to admit a ½-in. bar for twisting. To use the device the chain hooks are put into place on the rim and the pipe given a twist. This action winds the chains around the pipe, yet so great is the leverage obtainable that little actual strength is required to contract the rim. The illustration clearly shows the device and its attachment to the rim.

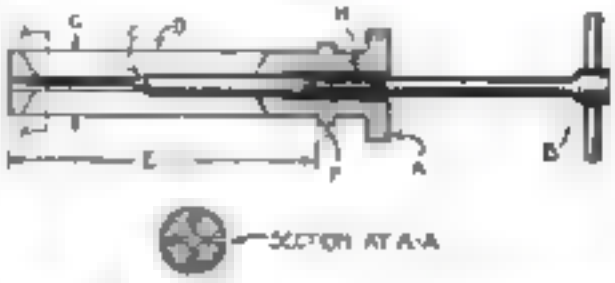
Try out this idea, and removing and replacing tires will be an easy job. If a little graphite is applied to the rim at the time of removal, tire-removing will be made even more easy.

For those who have bruised their fingers in removing split rims, this tire-remover will prove invaluable, for it eliminates all chance of injury to the person operating it.

A Tube-Pulling Wrench that Is Easy to Make

A NUMBER of short tubes or bushings which were a snug fit in larger and longer ones were to be removed, and after machine work was performed on them they were replaced.

A wrench to grip them on the inside was needed, since that was the only place to get a grip to remove them.



An entirely efficient tube-pulling wrench can be made as described in this article

The illustration shows the tool made for the work.

A piece of tool steel *A* was turned in the lathe to the shape shown, the size *G* was machined for the length of the dimension *E* to a sliding fit on the inside of the short tubes.

A small hole was drilled through the center of *A* nearly a third of its length, and a larger one two thirds of the way from the larger end.

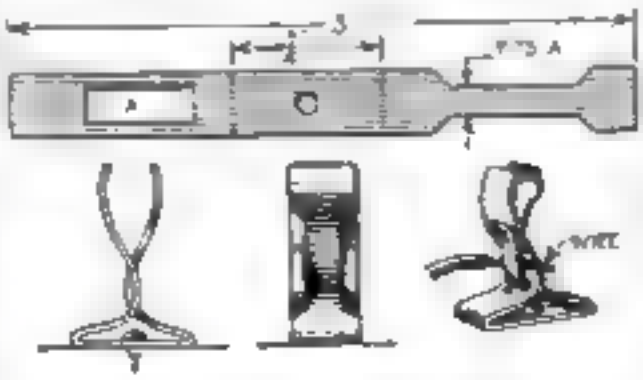
A cone was formed at *C* and threads tapped for a short distance in the larger hole at *H*. Narrow slots *D* were cut in the milling machine and a pin *B* with a cone point the same angle as the one at *C*, which, when made to fit was trued up and a hole bored at the outer end for a short pin to serve as a handle. The pin was threaded to match those at *H*. By turning this pin against the cone *C* the sides of the slotted portion of *A* expanded and had a tight hold on the inside of the small tubes.

The shoulder *F* gaged the tool to a certain depth.—E. S. Goodell.

A Spring Binding-Post Made of One Piece of Metal

A BINDING-POST made of one piece of metal makes a handy accessory for the amateur electrical experimenter. It is instantly adjusted, simple to make, and costs little.

Cut a piece of heavy spring brass the shape and dimensions shown in



A spring binding-post made in the manner illustrated insures a tight connection for electrical current passing through

the detail sketch. A No. 16 or No. 18 gage will do. The hole in the center

is to fasten the post to a suitable base. The narrow section is bent so that when it passes through the oblong opening in the opposite side, sufficient space will be provided between the two pieces before the ends of the opening interfere.

Also see that the tops of each side of the post do not touch before this same space is evident. Otherwise, the wire cannot be placed in the opening without some difficulty.

The metal should have sufficient springiness so that when the ends are released, the wire will be held securely between the sides of the post.

These can be used to connect the ends of two stray wires or to fasten to apparatus as permanent posts.

The Way to Cut Large Holes in Wood

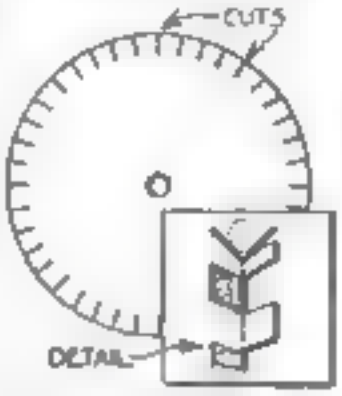
ALTHOUGH this method of cutting large holes may be used for cutting thin metal, and even glass, it is more practical for use on wood, especially where such devices as clocks, ammeters, etc., are to be installed on the dashboard or instrument board of an automobile.

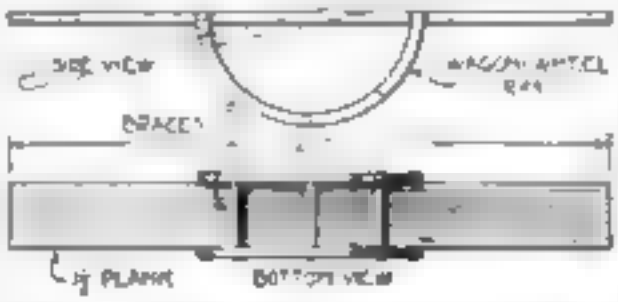
Obtain an old strip of band-saw and draw the temper by heating it to a

A strip of band-saw bent into a circle and riveted will cut any size hole

red heat in the fire, then letting it cool. The saw may then be bent into the circle desired and the ends cut and riveted to make a complete circle. After this is done, round off both ends of a flat piece of oak board to fit the inside of the circle and with four brads, fasten the circle to the board. Find the center of the device and pass a bolt through the board, thread on a nut, and it is done. It may be used in a bit-brace and will cut a perfectly round hole.

If more than one hole is to be cut, or if the device is made for use in the garage, the saw should be tempered again after it has been bent and riveted. To do this, heat to a bright cherry red, quench in water and draw the temper by holding for a short time in the heat, until the metal turns to a dark blue.





Making Grooved Pulleys from Tin

When you wish a grooved pulley for a toy machine, model, or other light use, you can make one out of sheet tin as described and save the expense of buying one.

Cut out a disk of sheet tin about ½ in. larger in diameter than the pulley. Punch a hole in the center for the axle. Then from that point, scribe a circle on the tin with a sharp point. This should be ½ in. less in diameter than the tin itself.

Cut the edge of the disk, and bend to make lugs as shown

Then cut at right angles to the circumference with tinner's shears as far as the scribed circle and about ½ in. apart, completely around the tin. This will leave lugs ¼ in. high and ½ in. wide which, when bent outward alternately, will form staggered sides of a groove and form a sort of grooved pulley which will serve all practical purposes.

These dimensions for the lugs will do for all ordinary narrow belts, but can be varied to suit any conditions.

Seesaw Made of Plank and Wheel Felloes

A handy form of seesaw for the children is shown in the accompanying illustration. It is portable, and thus makes itself useful in any location without having to hunt for a raised position on which to rock it.

The plank is of oak or hard pine 12 ft. long by 12 in. wide by 1½ in. thick. To each side, in the center and in exact line with each other, bolt two sections of a large wagon-wheel rim or felloe. These usually come in half sections, but should be cut a trifle so that they do not make complete semicircles.

The half wagon-wheels combining with the plank to make a safe seesaw for the children

Then insert several braces between sections as shown so they will keep a uniform distance apart.

This is a good idea for the children, because there is less danger of whirling and the possibility of the plank throwing itself off its fulcrum and giving the riders a bad fall.

Emery-Wheels Are Easily Made at Home

IT is not hard to make an emery-wheel that is very serviceable. In fact, it is so easy that no amateur mechanic need be without wheels of almost any desired size and any grade.

The first thing to do is to make a wood wheel of the right size, have it perfectly true and, preferably, run it on some sort of a metal hub. Around the rim glue securely a layer of felt, binding the fabric tightly while the glue is drying and using a broad binding so that the felt will not be uneven. Then coat the felt surface with hot glue and roll it in emery or carborundum or whatever abrasive is to be used. Have the abrasive hot—a good deal too hot to touch. It is important to have both glue and emery very hot. Put on three, or even four, coats of abrasive, waiting till one is thoroughly dry and hard before putting on the next. Wait a good long time to be quite sure of the hardness and dryness. This method is much more satisfactory than the common one of trying to make the abrasive stick to a plain wood surface, and is also an improvement over the use of a leather band as a base for the abrasive.

A layer of felt is glued to the wheel. Upon this are several layers of abrasive

Guarding Automobile Springs from Dirt

THE leaves of an automobile spring are intended to slide upon one another when the car is in motion. Many drivers allow their springs to get dirty, to go without lubrication, and to become very rusty. The leaves become so dirty that instead of sliding on each other, they work almost as if they were one solid piece of steel. Then, when the car strikes a hole or a bump in the road, the springs are compressed, and instead of each leaf working as a separate unit, the lower leaves of a rusty spring are held fast to the upper leaves and the reaction from the compression of such a spring is many times greater than the reaction of a clean, well-lubricated spring where the leaves are allowed to slip one on another.

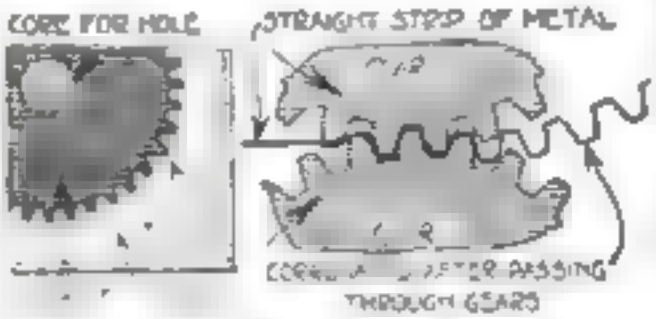
The first step toward a remedy is to keep mud and dirt and all foreign matter away from the springs. This can be done by covering the springs with boots, sewed together, made of a good grade of leather substitute. This material is thoroughly waterproof and will keep dirt and moisture away from the spring. The lubrication on springs protected in this way will remain in place a very long time.

Making Gear Patterns in Sheet Metal

By Thorton Hallett

GEARS for temporary use, as in model-making, experimental purposes, etc., can be made in the following manner by casting in soft metal and will be the means of saving much time, effort, and expense.

First, it will be assumed that the gears are to run in conjunction with some already in use, so they will have the same tooth dimensions and general characteristics. Make a note of the thickness, diameter, number of teeth, etc., that the gear you desire to make shall have, and then proceed to duplicate the teeth of the ones you will copy as follows:



The pattern and sand box are shown at the left. At the right is the strip of tin being perforated through the gears

If possible, adjust the gears in mesh so there will be some play between the top and bottom of the meshing teeth.

Then procure a strip of light, soft sheet metal as wide as the thickness of the gear desired and three and a half times longer than the distance around the circumference. Start the gears on the machine and very carefully feed the metal between them, just as washing is fed to a clothes-wringer. Be sure and hold it steadily at right angles to the face of the gears and do not force it through. The result will be that the strip will be pressed into corrugations exactly duplicating the teeth of the gears and can then be used for the pattern of a similar one.

When sufficient teeth impressions have been run into the metal strip, remove it and bend it into a circle and rivet one end to the opposite end so that the required number of teeth are included. Then snip away the surplus metal.

Make a shallow wooden box somewhat larger than the desired gear and mark a point in the exact center. Then with a compass, scribe a circle the outside dimension of the gear on the bottom of the box. This is used as a guide when laying the metal pattern out. Then affix a metal or clay spindle to the center of the box, which will act as a core for the shaft opening of gear.

When this is done, set the pattern over the core and arrange in as good a circle as possible about the core. Then pour in wet sand between the pattern and the sides of the box, and pat down, gently forcing it against all portions of the pattern until it assumes a perfectly circular shape, as indicated by the mark of the compass.

Then, without disturbing the arrangement, pour in the casting metal. This can be lead, pewter, or babbitt metal for such temporary gears. The result, when cold, will be a very fair gear of soft metal which will mesh with its mates as well as a cut one.

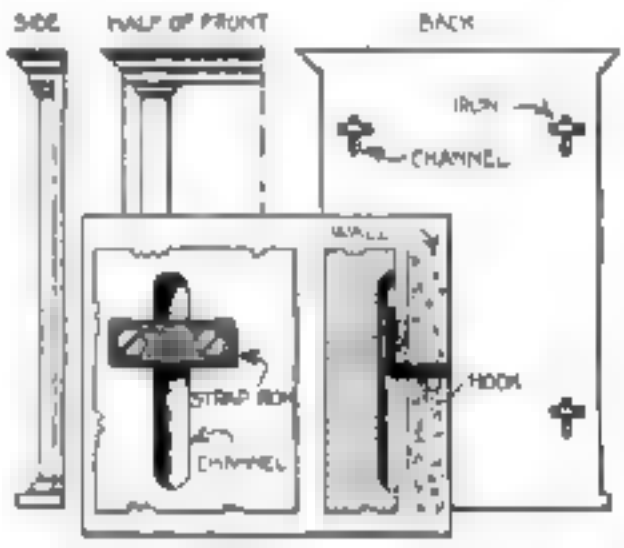
The keyway can be cut with a chisel. If the circumference is at all out of true, there will be sufficient metal in the casting so that it can be trued up in a lathe without sacrificing anything necessary. A shaft hole can also be quickly reamed out if necessary.

This mold can be used over and over again if a sand bottom is used and the pattern is kept trued up to a true circular form.

An Easy Way of Fastening a Wall Tablet

TO attach a "Roll of Honor" tablet to the wall of a lodge room, and also to arrange it so as to be readily removed if necessary, I fitted it as shown in the illustration.

Securing two small angle-irons I cut them so as to get four straight pieces. The reason I used angle-irons



Showing the side, front, and back of the tablet and how it is attached to the wall

was that they were already bored and countersunk for screws. Four channels were then gouged out immediately back of the pillars, and the angle-irons screwed across them. Four right-angled screw-hooks held the tablet against the wall. Lifting up and out would permit the tablet to be removed.

To allow for inequalities in the wall surface, I fitted the tablet so as to allow ½-in. space between it and the wall, but I could have made it fit snugly by setting the angle-irons in depressions cut in the board so that they would have been flush with the surface of the back.

When finished, the tablet will be flush with the wall and give the effect of being permanently fastened there. It can be removed for cleaning when

Two-unit electric system sets motorcycle standard

The appearance of the Two-Unit electric system in the 1920 Powerplus justified the dependence the Motorcycle World places upon the manufacturers of the Indian to originate and develop new ideas in motorcycle construction.

First introduced in 1918, it was called the Two-Unit system because two distinct requirements have been met by a compact assembly which provides two entirely independent current sources. The ignition system and the lighting system have no relation in duty. Their electrical supply, therefore, is entirely independent of each other.

This step marks a new advance in both simplicity and efficiency—a characteristic Indian achievement.

Department 38

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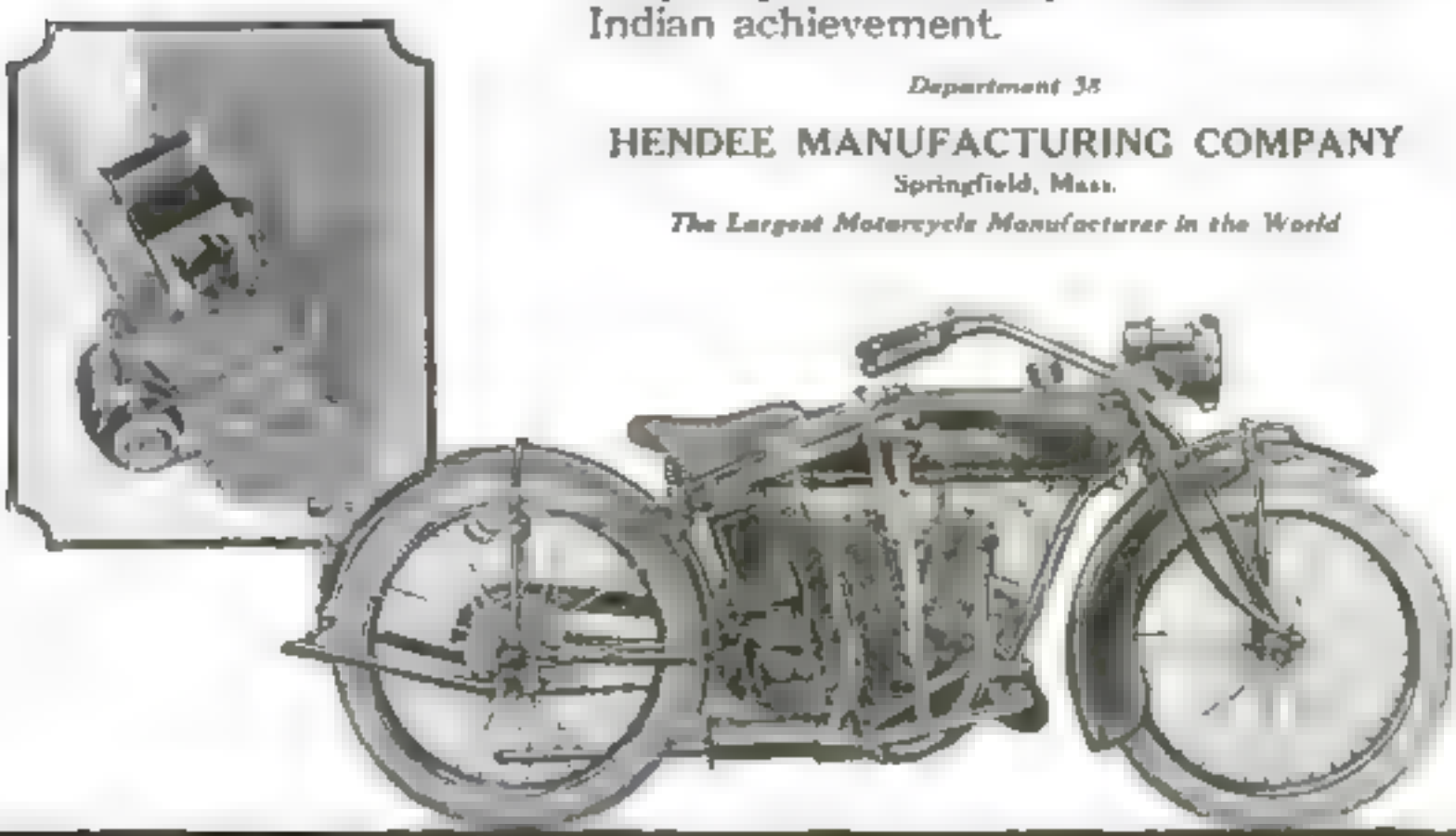
Ignition is supplied by the war-tested Aero high tension magneto which sparks at a very low speed, thus rendering the Powerplus remarkably easy to start.

The Lighting Unit is composed of a Splitdorf DU direct current generator, and a 6 volt Wico battery. The headlight has a 21 candle-power main bulb and a 2 candle-power pilot. The tail light and horn are energized by the same system. A Splitdorf zero-centre ammeter is mounted on the top of the tank. Single wire system is used throughout.



Indian Motocycle

For Sale by Dealers Everywhere

A Compact Typewriter Table and Stool

By Mortimer V. Tessier

ONE of the problems to solve in having your typewriter at home is to provide a proper table and seat which will have all the conveniences of an office without taking up much room and at the same time will make a presentable appearance in the home.

Here is a novel and compact outfit which requires but 31 in. by 15½ in. top measure, and is only 27 in. in height. The stool has a hand hole in the center of the seat for handling and fits snugly under the table when not in use.

A homemade typewriter table that takes but little space and gives one all the conveniences of an office desk

Besides giving plenty of room, as the illustration shows, for the typewriter, there is room on each side of the machine for a full-size sheet of business-letter paper, and an upright drawer is provided at each end of the table large enough to accommodate your typewriter paper, envelopes, etc. These drawers swing outward to open on two hinges placed at the bottom of the drawer, and are provided with a knob on the outside and a snap catch (such as is used on the doors of your china-closet or sideboard) which locks them when the drawer is brought to a vertical position. The drawer is kept from swinging too far out by means of a short length of small chain, which fastens at one end to a screw-eye in the back of the drawer and at the other end to another screw-eye in the lower edge of the upper crosspieces underneath the table-top.

The table shown in the illustration was constructed of cypress wood and afterward given an early-English water stain, and rubbed to a dull polish.

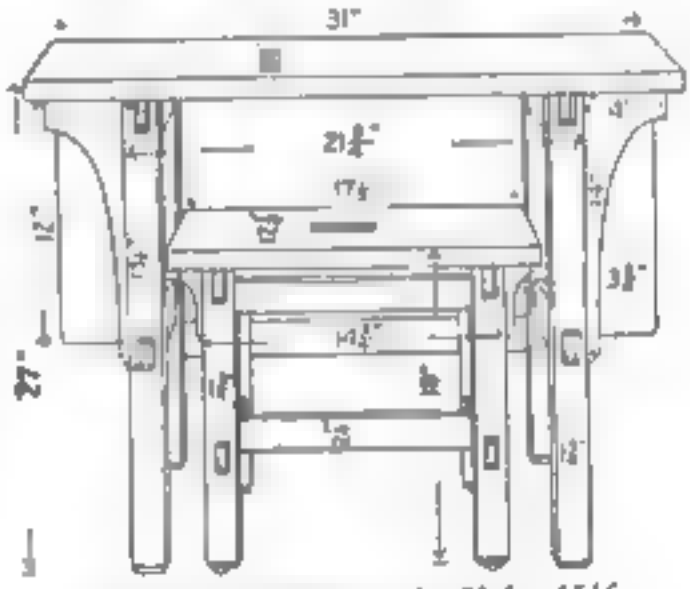
This outfit can be easily constructed at home by the man who enjoys making his own things rather than buying them.

The requirements for lumber, hardware, etc., are rather simple. First, you will need four small brass hinges, two small knobs, two small snap catches, such as are inserted in the edge of the drawer, about one foot of small chain, four screw-eyes, and four 2-in. strap-iron, right-angle corner braces. These corner braces are applied to the top of the table legs and the under side of the table-top to give added rigidity to the table.

Your requirements for lumber are as follows: For the table legs, four pieces 1¾ in. square and 27 in. long. For the stool legs, four pieces 1¾ in. square and 17 in. long. For the table-top, one piece 15½ in. by 31 in. by 1¼ in. thick. For the stool-top, one piece 12¾ in. by 17½ in. by 1¼ in. in thickness. All the crosspieces are of 1 in. by 2¼ in. stock and the brackets are of 1-in. stock, sizes as shown. The drawers are made of ¾-in. stock for front and back, and ½-in. for the sides and bottom.

General construction: The table-top is secured to the legs in addition to the brackets described above by a large countersunk screw in each leg. The head of the screw is let down into the top of the table about half its thickness and a cypress glue plug is then inserted to fill the hole, and afterward smoothed off.

The mortises and tenons in the table shown are worked clear through the legs, for ornament as much as for strength, but if desired these mortises can be made blind. All mortises and tenons are 1 in. by 2 in. The four brackets on the ends of the table are placed flush with the inside edges of the table legs and the drawers slide back and forth between them and rest against the upper and lower crosspieces when they are closed. There is a crosspiece between the back legs of the table, just below the lower-end crosspieces.



The table requires only 31 by 15½ inches of space in which to be stored. The stool slides beneath the table

The stool-top is secured to the legs in the same manner as the table and is provided with an "I" cross-brace between the legs. The ends of the stool legs are provided with rubber half-circular knobs, with a small screw in the center for attaching to the leg.

The top ends of the drawers are slanted slightly inward so that they will clear when brought to an upright position.

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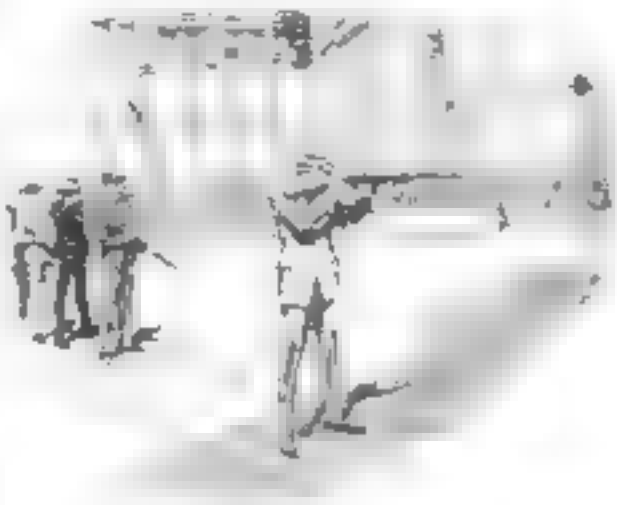
How to Become a Second Buffalo Bill

Promoting rifle practice for those who like to shoot

By Fred Gilman Jopp

HOW you envy the man who is an expert shot, and how you wish that you could shoot as well. Of course you realize that it takes lots of practice, but that you would gladly do



If possible, the range should be located near the town, so that members can reach it for shooting practice after business hours

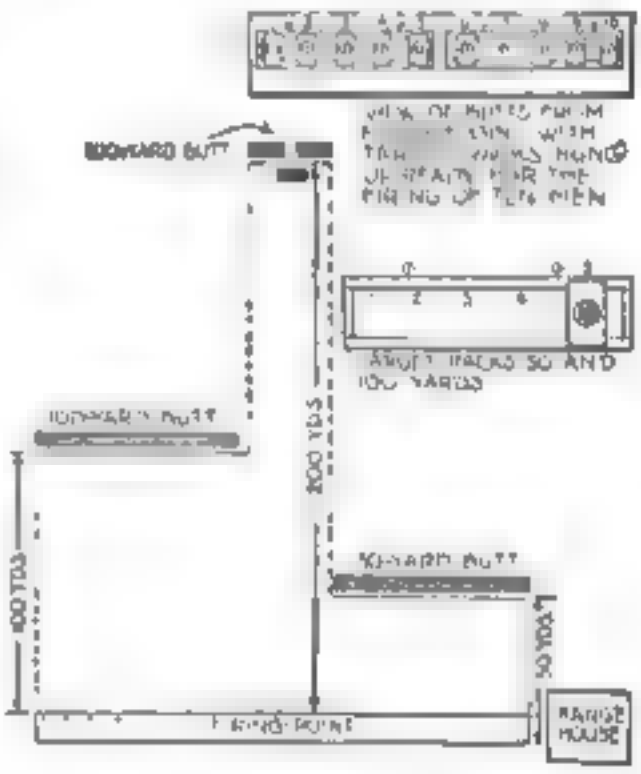
provided you had a place in which you could learn. Why not construct your own rifle range? It doesn't cost much provided you have a place in which the range can be installed.

Herewith are plans for inexpensive rifle-ranges for the small-bore 22-caliber rifle, such as several men forming a club can erect on any suitable piece of ground in two afternoons' work. Only inexpensive material is required. In many cases old packing-boxes, railroad-ties, and gunnysacks filled with dirt can be used. Often the ground itself will lead to modifications which will decrease labor and expense.

A suitable piece of ground is the first requisite. Any piece of land at least 100 yd. long by 50 yd. wide can be used. If you find difficulty in obtaining the ground, you should apply to your city council, board of trade, chamber of commerce, or to public-spirited citizens. In a number of cases cities and towns are providing places in parks for these ranges. In other cases public-spirited corporations are permitting the use of vacant land. It is important that the land selected is readily accessible. Be sure that the range is safe, and not liable to be closed by injunction. Make positive that bullets will not go astray. Remember that the extreme range of the 22-caliber long rifle cartridge is just about one mile, and that at 600 yd. it will penetrate a 1-in. elm plank.

Relative to the construction of the 200-yd. butts, it is recommended that the target carriers be made large enough to take paper targets about 4 ft. square. In some cases the amateur will find it difficult to keep all his hits on the target, and also to find the target, when he first starts to shoot.

There should be some means of finding and accurately marking the misses. This is easily accomplished by placing a piece of paper about 4 ft. square on the carrier, and then placing or pasting the target in the center of this piece of paper. This sheet of paper should always be painted dark green before pasting the target upon



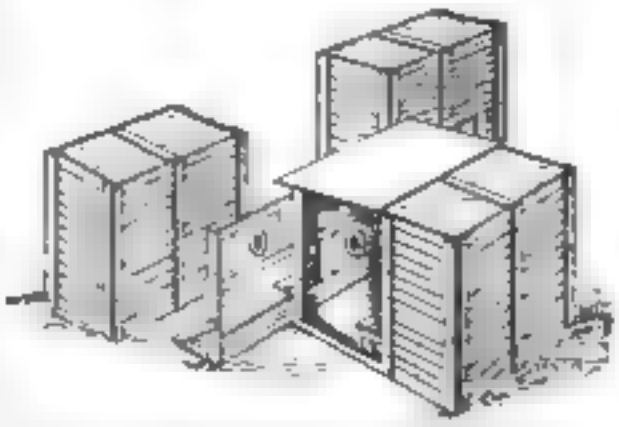
Here is the 200-yard small-bore butt comprising target-house, marker's shelter, target-carriers, and back stop. The construction is simple and inexpensive

it, giving the target the same appearance from the firing-point as does the large 1000-yd. target on the big-bore ranges, and more closely simulating long-range shooting.

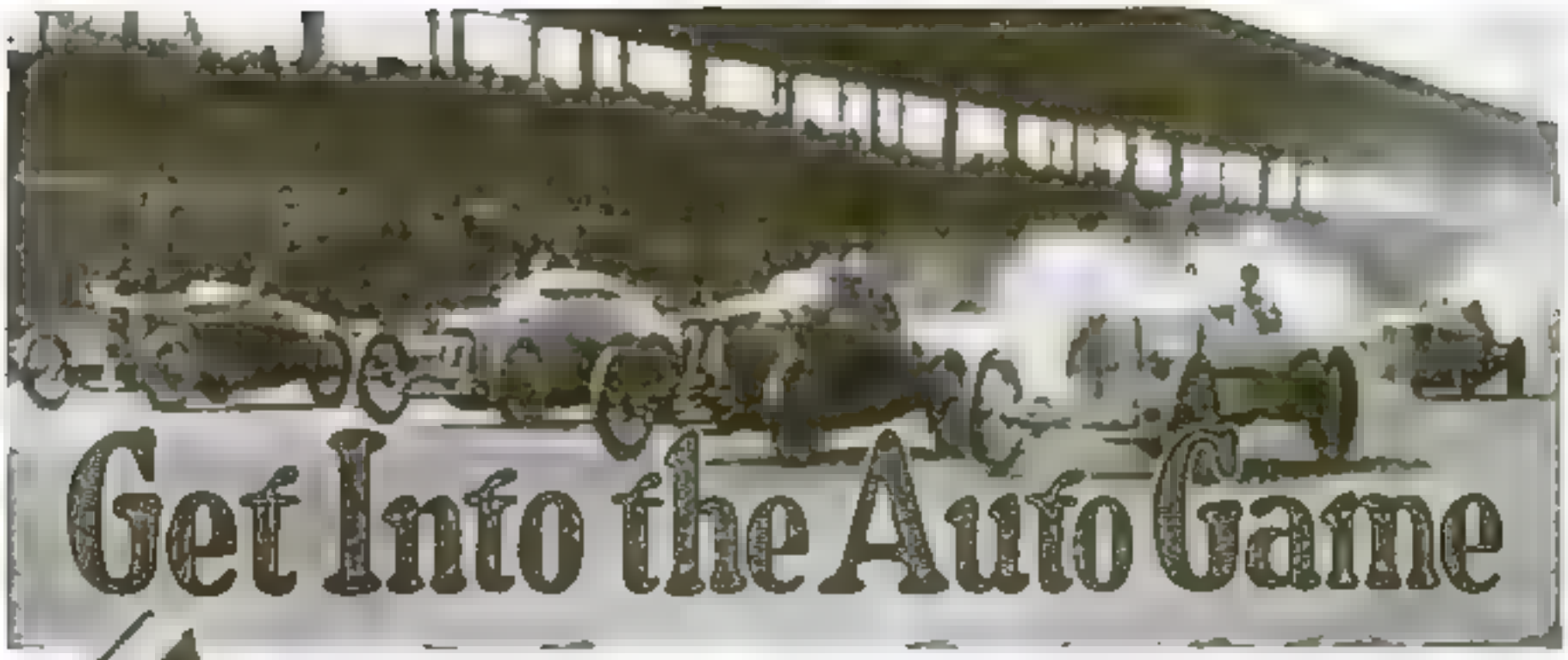
Each member of the team should shoot scores as follows: 50 yards, 10 shots, slow fire, time limit five minutes for 10 shots.

100 yards, 10 shots, slow fire, time limit five minutes for 10 shots; any position without artificial rest. Rifle: any 22-caliber rim-fire rifle; any sight not containing glass.

Mr. F. H. Phillips, Jr., Secretary N. R. A., 1108 Woodward Building, Washington, D. C., will furnish any further information and plans. Write to him.



With a roofed-over firing-point in winter, the sides can be boarded in, with loopholes to fire through, and a stove for comfort inside



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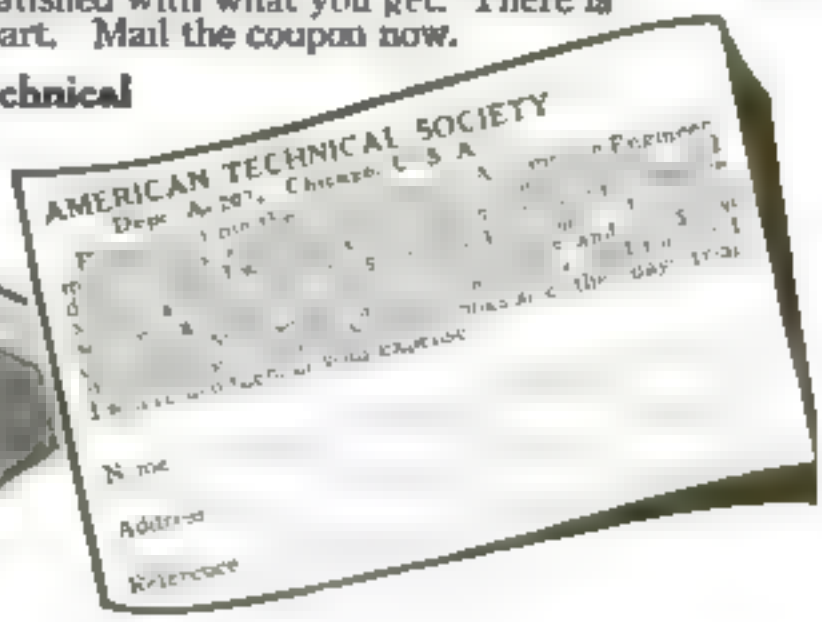
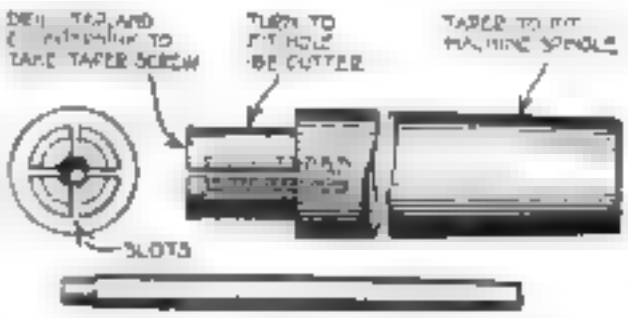


Send the Coupon Now

A Specially Made Arbor for Face-Milling

RECENTLY I was called upon to do a piece of work on a milling-machine which was beyond the range of any tools I had. The job was one for a face-cutter, but not having any that would reach the work I made a



The arbor may be used for spot-facing and other work done with end-mills

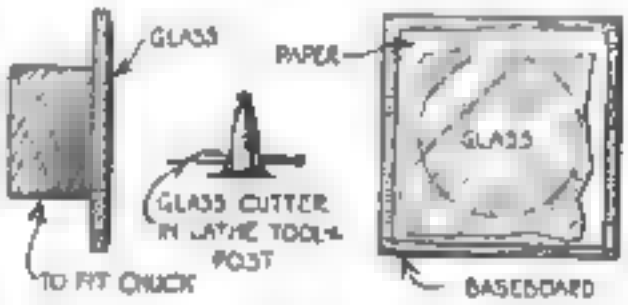
special arbor to carry the cutter as shown in the illustration.

The arbor was tapered to fit the spindle of the miller and turned down as shown to fit the hole of the cutter. A hole was drilled and tapered in the end and countersunk to take a taper screw. The screw was tightened sufficiently to prevent the cutter from turning on the arbor.—HARVEY MEAD.

Cutting Circular Glass Plates on a Lathe

CUTTING out glasses for headlights, etc., is not always easy for the man not blessed with a multitude of tools for glass-cutting, but if he has a lathe, here is the way it can be done.

First build a wooden base after the pattern shown in the drawing. This can be made as large as convenient,



How to cut a circular piece of glass on a lathe without fear of its breaking

but of course the tool-holder of the lathe can be moved only a certain distance from the center of the chuck, so allowance must be made for that. The block under the baseboard is to attach to the chuck, so make this of a size to suit your own particular lathe.

Since glass cannot be clamped to the base without the danger of a break, owing to the uneven strain of the clamps, a novel way is herein described. First, see that the base is perfectly straight, both across and with the grain. Any excessive warping will cause such curving of the wood as to make it dangerous to attach a sheet of valuable glass.

Next, spread glue to the baseboard and lay on a sheet of heavy manila

paper, spreading evenly to remove all wrinkles. When this is thoroughly dry, give the paper a coating of glue in the same manner and lay on the glass, centering it as evenly as possible. When this second application of glue is dry, the glass is ready for cutting.

Mount the baseboard in the chuck and bring the tail-stock up to the glass to determine the center point. Measuring out from this point will determine the radius at which you will cut

The glass-cutter should be set in the tool-holder so the wheel will bear against the glass at an angle best adapted for cutting This can be determined by experiment.

Gear the chuck down to a very low speed and bring the cutter against the glass at the proper point.

When the cut is made, remove the base from the chuck and dampen the paper with water. This will allow the glass to be slipped off and the excess glass broken away.

To Make a Universal Joint for Temporary Use

A SIMPLE universal joint that may be used in light drilling, valve-grinding, machine-driving, etc., is illustrated which can be quickly made by any amateur mechanic from old pieces picked up around the shop.

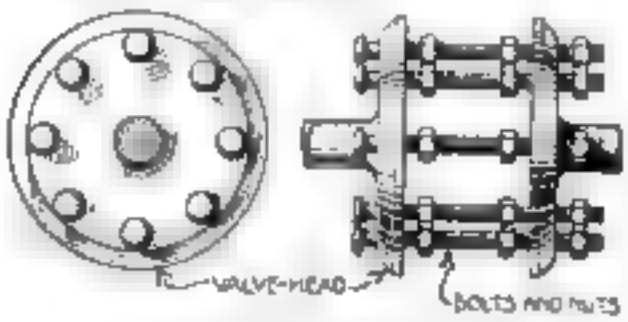
Take two old gas-engine valve-stems and drill eight 3/16-in. holes concentric with the circumference and about 3/8 in. from the edge in each one.

Then take the firing-points from eight old spark-plugs (the threaded style of point) or make up eight sections of bicycle-spoke stock about 1 1/4 in. long. Thread these for nearly their entire length. Head over each piece at one end and provide three nuts for each, making 24 nuts in all.

Connect the two valve-heads as shown, allowing some play between the valve-heads and the nuts on the outside. Also allow some room between the nuts at the end of the rods and the valve-head.

This arrangement will allow the valve-stems to be rotated at an angle sufficient to overcome many difficulties in mechanical work.

Practical use can be made of this joint by connecting the valve-stems to shafting as necessary. After the universal joint is constructed and tried out, the machinery about the shop will, no doubt, suggest other ways in which this very necessary piece of apparatus can be used.

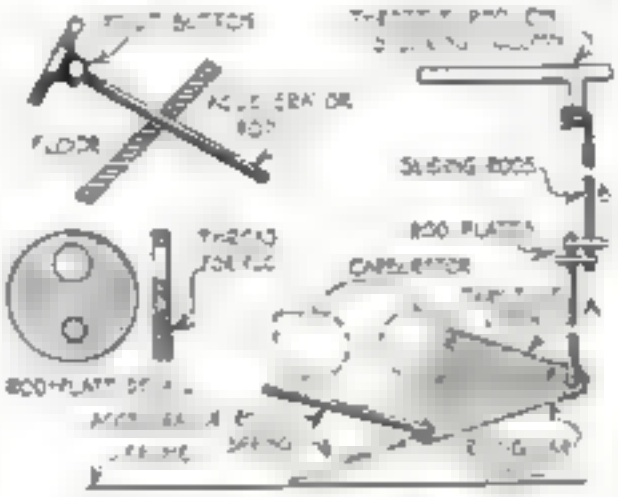


This temporary universal joint was made from old gas-engine valve stems and spark plugs

A Homemade Accelerator for the Ford Car

AN accelerator for your Ford, by which the speed of the car can be controlled by the foot, can be made at home of odds and ends about the workbench at practically no cost. The general layout showing the operation of this idea is shown in the illustration, with all details of individual parts.

First, the rod connecting the rod from the steering-wheel to the throttle-lever on the carburetor is removed.



Here are the various parts needed for your homemade Ford foot accelerator

This is sawed in half. One half is threaded at the cut end and a second piece of similar rod, about 1 in. longer than the remaining half, is threaded at one end and bent and drilled to fit the rod from the steering-wheel. The combined length of these rods should be an inch or so more than the distance from the carburetor throttle-lever to the control-rod from steering-wheel, when carburetor is nearly closed.

Next, cut out two egg-shaped metal plates for slides. These are shown in detail

At the narrow ends drill a hole and tap it to thread on to the threaded ends of throttle-rods. Just above this hole, drill a larger one to slide over the rods easily. Then assemble them as shown in the layout, so each plate slides over the other rod. When they bring up against each other, their combined length will be just equal to the length of the old throttle-rod.

The triangular plate is composed of heavy sheet metal about the shape shown. Drill three screw-holes at the points indicated, also two larger holes for the control-rods.

Then drill and tap three machine-screw-holes in the carburetor lever and attach the plate to it in the position shown.

The throttle-lever hole in the plate should coincide with that in the lever

A spiral spring is then attached from the other control-rod hole to the frame, always tending to keep the lever in closed position.

Connect the sliding rods in position as usual and then connect the accelerator rod, which is composed of similar stock, to the plate and lead it through the flooring as shown. A metal button can be threaded to the end of this

rod and can be removed when necessary to take up the flooring.

When the hand throttle is closed, the two slides are against each other. But if the accelerator is pushed down, that opens the carburetor also, one half the sliding rod pushing over the other, thus not disturbing the hand throttle in the least. When the accelerator is released, the spring pulls the carburetor shut to the original points held by the hand throttle.

Slight adjustments will be necessary when assembling, but, once made, will be found to operate as well as the bought ones.—WINDSOR CROWELL.

A Mirror that Will Reflect Hidden Engine Parts

UNFORTUNATELY our eyes are not like those of the lobster, mounted on long posts and sticking out of our heads. If they were we should have little trouble seeing into a transmission or engine cylinder. Since we are handicapped by nature's mistake, we must make the best of the situation and use tools or devices to suit the occasion.

Illustrated below is a combination mirror and lamp, which can be used for inspecting the inside of the engine, the transmission, or the differential

The mirror should not be more than 2 in. in diameter, the lamp bulb a regular six-volt and operated from the storage battery

There are two features to be considered in making the device. First,

With the combination mirror and trouble lamp you can find that lost nut or broken part

flexibility, and second, illuminating qualities. Obviously the light will be of but little use unless it is mounted on a flexible tube. The ordinary armored cable cover, or flexible metal gasoline hose of small diameter answers the purpose very well. With this sort of tubing, the light and mirror may be put into almost inaccessible places and conditions inspected.

The second point to be considered is the location of the light bulb. If the bulb is located below the mirror, on the tube, it will shine in the eyes of the operator. The best location is shown, at the top of the mirror, where it can be shielded from the operator's eyes, yet give maximum illumination.

A Turntable Handles Heavy Parts on a Work-Bench

WHEN heavy articles, such as cylinder blocks, fly-wheels, storage batteries, etc., are being handled on a work-bench, considerable effort is required to constantly turn them about and back and forth for inspection and alteration. Consequently a

A turntable mounted on a work-bench will greatly aid the mechanic in turning heavy parts in the position desired

turntable attached to the bench would be a labor-saver and a convenience for the workman.

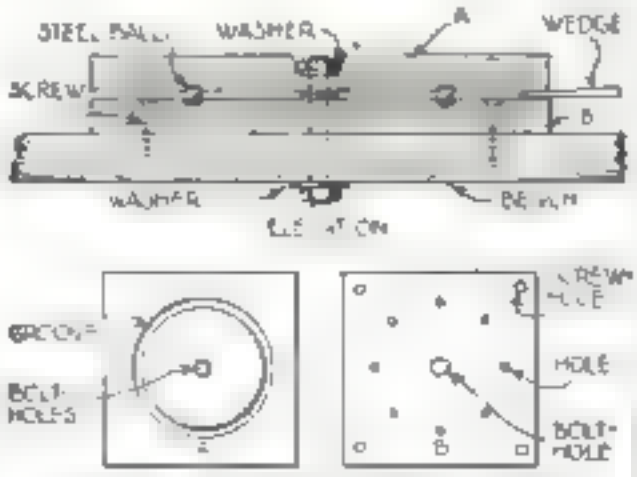
To make such a turntable, procure two blocks of hard wood of the required size to handle your particular kind of work. A fair size would be 15 in. square by 2 in. thick.

Select a position on the bench little used for general work and use this for the turntable.

Bore a hole in the center of each block through which a large bolt can be inserted. Then lay out a circle on one face of each block, the same diameter.

In several points about the circle on block *B* drill shallow holes with a tapered or round bottom. Then take block *A* and center it upon a lathe-chuck and, with a round end cutting tool, turn a shallow groove which will coincide with the holes in block *B* when they are laid together, centers matching.

Fasten block *B* to the bench with four long screws or bolts. Set sufficiently large automobile bearing-balls in each hole in the top of the block, so that when the groove of block *A* is



DETAIL OF BLOCKS SHOWING BALL RACE

Two blocks of hard wood are required to make the turntable. Ball-bearings set between them make it turn easily

inverted over them, they will clear the surfaces of the two blocks by a fraction of an inch. Previous to this fill the holes and groove with grease.

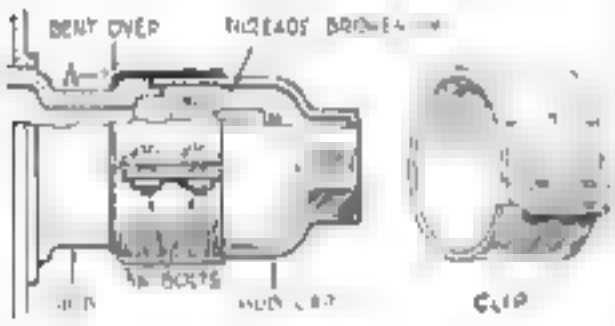
Bore a hole through the bench to correspond to the center holes in the blocks and pivot the whole affair together with a large bolt and washers as shown in the detail. Countersink the head of the bolt in the upper block *A*.

With this arrangement heavy weights can be turned in any direction with a minimum of effort. To set the table at any point so that it will remain rigid, simply force a narrow metal wedge between the blocks as shown.

How to Fit a Hub Cap When the Thread is Broken

ONE of the most annoying of the petty accidents that happen, is to knock off a hub cap by grazing a gatepost or other obstacle.

This usually means nothing more than fifteen cents for a new cap, but



When the treads are stripped on your car's hub cap, you can make an emergency repair

occasionally a piece of the thread is broken out at the same time

This happened to me one winter when, owing to the ice-covered road surface, I skidded into a fence, knocking off a front hub cap and part of the thread as well. I found that there was not enough thread left to hold a new cap in place. The service-station man said that the only possible repair was to get a new hub body, costing $2.50. However, not wanting to go to that expense, also wanting to keep the mud and rain out of the ball races, I made a repair in the following manner:

A piece of metal 1½ in. wide by 8 in. long was procured from a junk-pile, and bent into the form of a clip that would clamp tightly round the hub cap, two 8-16 in. stove bolts being used to tighten the clip.

The cap and clip are put in position on the hub with the edge of the clip projecting over the edge of the depression in the hub body as shown. The clip is then tightened up and its overhanging edge knocked down with a light hammer

This will make a good solid repair and if the hub cap is filled with grease the bearing will be as weatherproof as ever.

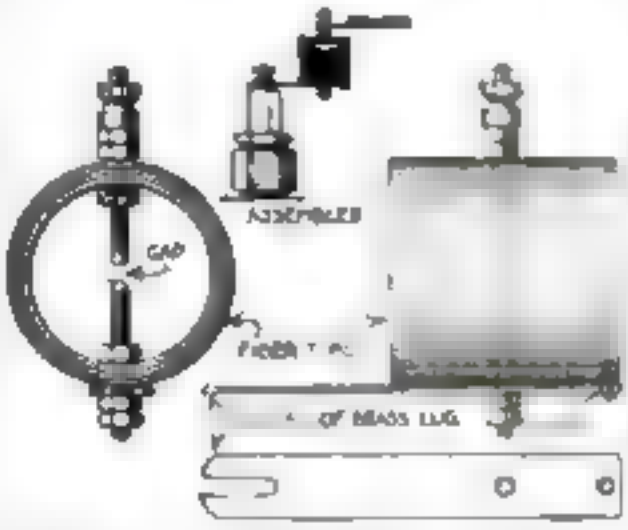
Examine the clip every now and then to see that the bolts have not become loosened or that the cap is not leaking grease.

An Efficient Homemade Spark Intensifier

THERE are many auxiliary spark intensifiers or spark-gaps on the market at present for overcoming spark-plug trouble and increasing mileage in automobiles. These can be used just as efficiently on stationary or motor-boat engines. But where the commercial article costs nearly four dollars for a set of four, the home mechanic can make such a set for practically nothing.

The body of the intensifier consists of a section of fiber or hard rubber tubing.

The fiber is preferable, as it is better able to withstand the heat of the



This spark intensifier enables you to discover the spark-plug that is not firing

engine. For this purpose use tubing about 1 in. inside diameter and cut each section 1½ in. long. Drill two holes ⅛ in. in diameter through opposite sides of the section, exactly in line with each other. Then drill a third hole, somewhat smaller, near one edge and in line, on one side, with one of the holes. That makes one hole in one side of the tube and two holes in the side opposite it.

Next, remove the threaded steel rod comprising the sparking terminal in the porcelain of an old spark-plug. Cut it in half and blunt one end of each piece. Now insert one piece of this rod in each of the opposite holes in the fiber section. Lock in position with nuts removed from spark-plug assemblies as shown, so the rounded ends are separated about 1/32 in., possibly a trifle more. This will have to be determined by experiment after the intensifier is put in operation.

Between the two underneath nuts and the fiber is placed a stiff brass strip with a slot in one end. The slotted end projects beyond the fiber far enough so it can be attached to the spark-plug. The opposite end is screwed to fiber through the third hole previously mentioned.

The connection of the intensifier with the spark-plug is shown. By arranging each section so the opening faces the side on which the hood is usually lifted, the driver can always watch the spark jumping across the gap and can thus determine instantly any cylinder that is not firing properly.

Save Your Spare Tires by Covering Them

AUTOMOBILE tires are wrapped in paper by the manufacturer because tire-makers know that sunlight and air sap the strength of rubber. The tire should be protected until it actually goes on the rim for road service.

Statistics prove that a tire good for an average of 6000 miles when it leaves the factory will lose approximately 2000 miles of life by being carried, *unprotected*, as a spare for one year.

A tire cover made of rubberized coated fabric will outlast many tires. It will cost less than the 2000 lost mileage on one unprotected tire.

Neatly covered tires look so much better hanging on the back of the machine than do bare tires. The covers are waterproof and can be washed without injury as often as the car is washed. They come in colors to match the body finish.

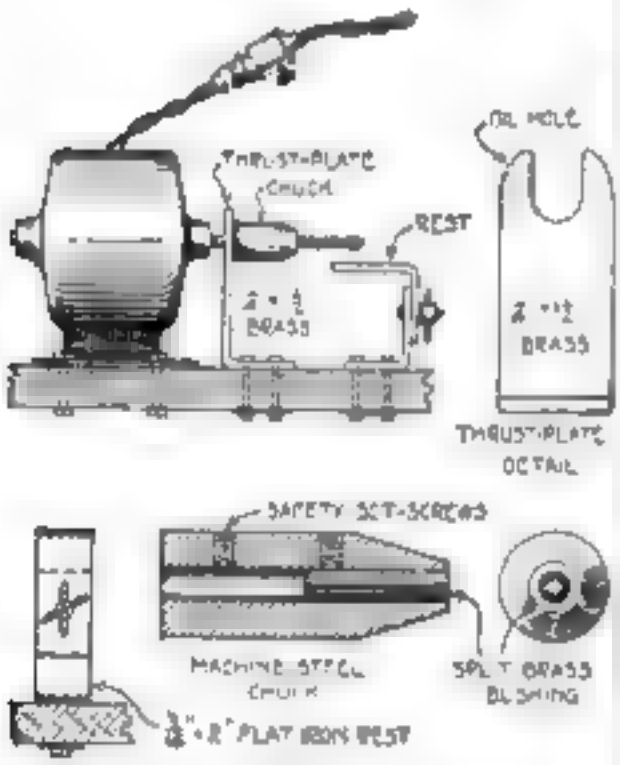
Therefore, both from the standpoint of appearance and economy, "cover your tires to save your spares" is good, sound advice.

Using the Electric Motor for Reaming and Drilling

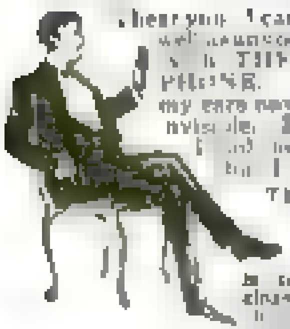
MANY a hand job in the shop which takes a long time can be done with a small electric motor in one fourth the time, provided one knows how. Here is the way to do it:

Remove the motor's pulley and make a chuck, as shown at the top of the illustration, using safety set-screws for the jaw and screw. Interchangeable bushing split longitudinally with a hacksaw forms fine jaws which will hold a bit firmly.

Reamers may be used and the chuck can be replaced with an emery-wheel and the rest moved up to it by interchangeable bolt holes. For light bench work the motor works fine.

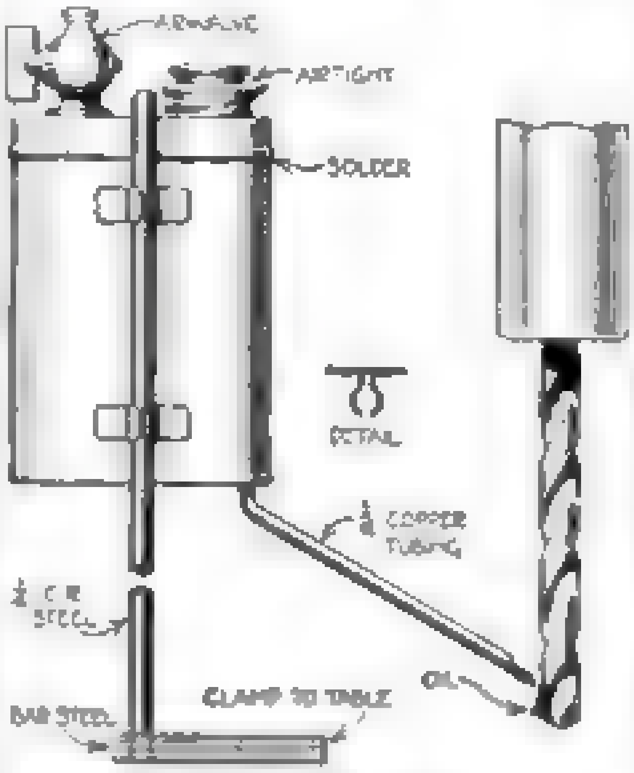


Here are the details for adapting your electric motor to reaming and drilling jobs which were formerly done by hand



A Lubricant Feeder for a Drill-Press or Lathe

THE illustration shows an easily made container to hold oil or other lubricant and which can be either clamped to the table or work on a drill press or other machine, or which can be arranged to ride along on the tool slide of a lathe. A small tin can of rectangular shape is obtained, a brass air-cock or priming-cup, a short length of copper tubing about 3/16-in. in diameter, a piece of ¼- or 5/16-in. cold-rolled steel, a short square bar of iron or steel, some pieces of heavy sheet brass, and the screw top from a small-sized automobile-lubricating oil-can. This latter should have a cork bottom on the plug to insure an airtight joint when the plug is screwed home.



The drill-point gets hot if there is no lubricant constantly pouring upon it. Here is a way to make a feeder deliver the oil

A hole is cut in one end of the cover of the rectangular can and the filling-plug soldered in; then the air-valve is soldered in the other end as shown in the illustration. The copper tube is soldered into the bottom of the can at any convenient point, using plenty of solder to make a secure joint. Four brass clips are cut and bent up and soldered to the can, being adjusted to hold it by friction at any point on the rod. At the same time it may be easily slid up and down as required. The top of the can is then soldered on, running the solder all around and through the joint, then blow into the can and test it to make sure there are no air leaks, for the flow of oil is to be shut off by closing the air-cock and any small air leak elsewhere would prevent this. The upright rod is screwed into the square bar and by means of a "C" clamp this bar may be clamped to the drill-table or tool-slide.

To use the device, open the air-valve, take out the filling plug, and fill the container with lubricant; then screw the plug tightly in, close the air-cock and adjust in position on the machine so that the oil-pipe will deliver the lubricant at the proper

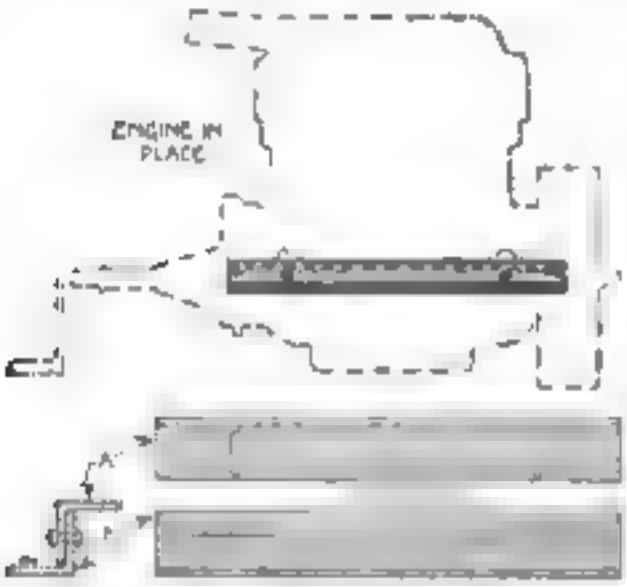
position over the tool or work. When the machine starts, open the air-valve and the lubricant will start to flow and its volume may be regulated by closing the valve to the right degree.

If desired, a more substantial and better-looking oil-feeder could be made up from heavy brass and a special filling plug fitted, though the extemporized one shown in the illustration will work as well as any.

Make a Motor or Engine Bed of Pieces of Angle-Iron

AFTER a motor or engine is set up on the foundation, the belt stretches or the shafting works out of line. This often necessitates moving the position of the motor a trifle and is an awkward task and an expensive one if the fixtures are set solidly in place. To make the process more simple, a sliding base should be made as shown. This is made of two lengths of angle-iron and bolted to the base itself

Cut two pieces a little longer than the motor or engine base. One, *A*



A good sliding base for an engine or motor can be made from two pieces of angle-iron

(the top member), has two slots cut crossways of the top face, placed the right distance apart to accommodate the anchor-bolts of the machine base. The bottom member, *B*, has two slots cut parallel to its length. Bolts from the upright face of *A* slide in these slots and make it easy to change the position of *A* with reference to *B*.

Section *B* is bolted to the foundation and *A* is loose bolted to *B* as just mentioned. Then the machine is fastened to the top faces of *A*. Two sets of these should of course be provided, one for each side of the machine.

If the machine is out of line with the shaft pulley, the bolts through the top of *A* are shifted. If the belt grows slack, move the machine back by loosening up on the bolts in *B*, taking up again when adjustment is made.

The simplest engine bed is, at best, difficult of construction. However, if the mechanic follows the foregoing instructions, he will find no difficulty in setting up the engine or motor in such a position that it will not vibrate

How to Sharpen a Scraper Properly

SOME one, some time, told me how to sharpen a scraper for floors or cabinet-work that will last a long time and insure a perfect cutting edge.

You are familiar with the ordinary blade used for such purposes—size 3 by 4½ in. Place it flat side down on a box of convenient size to sit upon, allowing the end to project about an inch, drive three or four shingle-nails into the box close to the blade, and bend them over to hold the blade perfectly rigid. Take a flat file and,

The scraper is first nailed to a box, then a file is used until the scraper has a feather edge

sitting astride the box, make a long bevel until you get a feather edge, being careful that it is square, or you may round the corners a trifle. Remove the blade and place it in the clamp, procured for this purpose, using a wrench to set up the nuts.

Fasten a nail-set on the other end of the box with staples or nails. Now, holding the clamp in both hands, bevel side of blade down, slightly tilted toward the operator, draw it across the nail-set, first one way and then the other, allowing it to slip off the nail-set to insure turning the edge throughout its length.

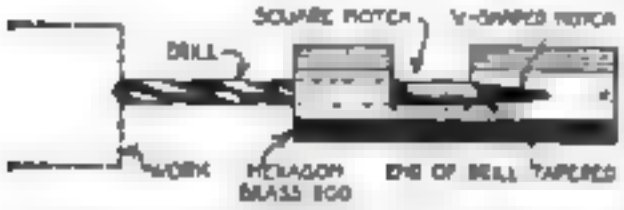
One needs to use considerable force in order to turn the edge, which should not exceed 1/16 in. Less than this will do.

In the next step take an old file or a new one—very fine—passed lightly over the feather edge to make it smooth. A scraper so sharpened will improve with use. As soon as it fails to cut properly run the file along the top, holding the blade perpendicularly in the left hand, cutting edge toward you, and then with the small end of the file hook it under the turned-over edge, lifting up and pulling it across two or three times, this last act lifting up the edge.

If the blade has been properly turned, it is quite possible to use it for two or three hours by occasionally drawing the file across it.—M. S. LORD.

A Holder for a Center Clearance Drill

A VERY simple and handy tool for machinists, especially for those not supplied with combination centering drills, is shown in the illustration. The tool consists of a piece of hexagon brass with a notch cut out as shown, a V-shaped opening cut in the center with a hacksaw, a hole



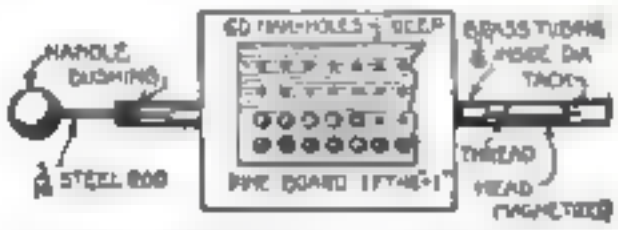
A piece of hexagon-shaped brass with a V-shaped opening makes a good drill-holder

drilled to receive the shank of a drill, and a center hole drilled in the opposite end. The hexagon shape affords a ready grip for the hand. The dotted lines show the work when the holder is in position for use after being centered. The straight shank of the drill is ground tapering like a chisel edge to fit into the V-shaped notch cut in the holder.—W. H. UNDERWOOD.

An Efficient Driver of Carpet-Tacks

BRIEFLY, the driver consists of a shaft with a magnetized head which slides back and forth within a brass tube. A bushing at the upper end of the tube prevents the rod from coming out, and the handle keeps the head from going farther than the lower end of the tube.

Procure a seamless brass tube 10 in. long with an inside diameter of 7/16 in. A steel rod, 3/16 in. and 8 in. long is then found and each end threaded. On to one end is screwed a cast-iron handle of any suitable size after it has been tapped and a steel head two inches long and small enough to just fit inside the tubing tapped and screwed to the other. The rod is of a



A single push of the handle through the tube drives the tack home in the carpet

length which will bring the shank of the handle even with one end of the tube and the bottom of the head with the other, and should be exact to work well.

A brass bushing made of a short length of smaller tubing or hard wood is then inserted into the upper end of the tube, held fast with short screws through the sides. If the brass bushing is used, it may be burred to fit tightly and thus do away with the

The Secret of Masterful Achievement

Don't Be Discouraged Wake Up!

Do you know that riches and success depend almost entirely on physical stamina and power — HEALTH! Here are the amazing stories of physical wrecks and business failures who have "come back." Some weakness or ailment may at this very minute, be robbing you of the success you deserve. I can make a man of you and put you on the road to achievement. Let me prove it.

By Lionel Strongfort

THE only difference between a rut and a grave is the width and depth. It was never said that if you fall in a rut either in your home life or in your work you will be in the grave. But only five men out of every hundred who reach the age of twenty-five chest poverty and death to live and enjoy their wealth at the age of sixty-five. The other ninety-five are either barely maintained or dependent upon the generosity of others or dead the other half way.

For the sake of your future happiness and success, just pause and think. Where do you stand? Are you in a rut? Are you in the right place? Are you doing the work you are best fitted for? Are you in the right line? Are you in your home life, in your business, in your work, in your pleasures, in your ambitions, in your hopes, in your ideals, in your aspirations, in your ambitions, in your hopes, in your ideals, in your aspirations, in your ambitions, in your hopes, in your ideals, in your aspirations

necessity of screws or rivets. The rod is then inserted and the handle and head screwed tight.

Magnetizing the head is easily done by rubbing the face of it over a permanent magnet. The better the steel used, the more lasting will be the magnetic influence, but the head may be re-magnetized as often as it requires it. Once a season will be sufficient.

This driver is very simple and is easily manipulated. To facilitate the task of laying the carpet, a pine board 1 ft. long and 4 in. wide was cut and a number of nail holes made in it over its surface with a sixpenny nail to a depth of 3/4 in. Preparatory to the carpet-laying, tacks were set into these holes.

In laying the carpet, one hand may be kept at the edge of the carpet, holding it in place and preventing any slack while the other operates the tack-driver.

Grasping the top of the tube and handle in the one hand, a tack is picked from the board, and setting the bottom of the tube over the proper point, the tube is released, at the same time raising the handle. A single drive of the handle downward will drive the tack home, and another tack is picked up and driven by the same operation. It will be seen readily that this method easily supersedes the usual method, but this tool has only to be made and used to be thoroughly appreciated.

Some New Uses for Old Automobile Tires

INSTEAD of selling all your old automobile shoes for junk, why not make some use of them about the house? Lumber and metal piping cost money today, but sections of tires can be used for water-troughs and spouts to good advantage.

A section about 1 1/2 ft. long placed under the gutter-pipe from the roof

More uses for old tires appear every day. Here is a way to save buying metal piping

will serve to lead the water away where it will not wash out the underpinning of the house.

Likewise a short piece slipped over the spout of the pump can be used to lead water into a trough without splashing. Several sections lapped together can be made to conduct water a considerable distance.

These are only two uses for old tires, and, as the illustration shows, they are made to serve excellent purposes. Does this article suggest other uses to which an old tire may be put?

A Pocket Voltmeter in an Old Watch-Case

THIS is a very accurate instrument, and can be made by even a boy, from materials found in or around the workshop. The case from any old "dollar watch" will do, though a No. 18-size case is to be preferred.

After you have found a suitable case, make a permanent magnet by bending a thin piece of steel into shape, as shown in the illustration. On the inside of the legs place the pole pieces, which should be made of soft iron and attached to the magnet by a small screw in each.

An old watch-case and a home-wound coil will make a pocket voltmeter

Then you magnetize the magnet by rubbing briskly on an ordinary horseshoe magnet. Then attach the magnet and pole pieces to the case by means of two small screws, each with leather washer for insulation.

The next step is to make the moving part of armature.

Bend a thin strip of aluminum into the shape of a hollow square; wind with small magnet wire. The pointer (which may be one of the old hands of the watch, or a thin piece of steel) comes next. Solder it to the end, at right angles to the direction of the wire. Then set the moving part in the watch-case by soldering two bearings or jewels of the old watch to a strip running across the watch, but insulated from the magnet.

Attach a spring to each end of the frame so that, as it revolves, one spring is wound and the other unwound. This will keep the moving part balanced. Attach a fine, covered wire to each spring and run out through the stem socket of watch-case.

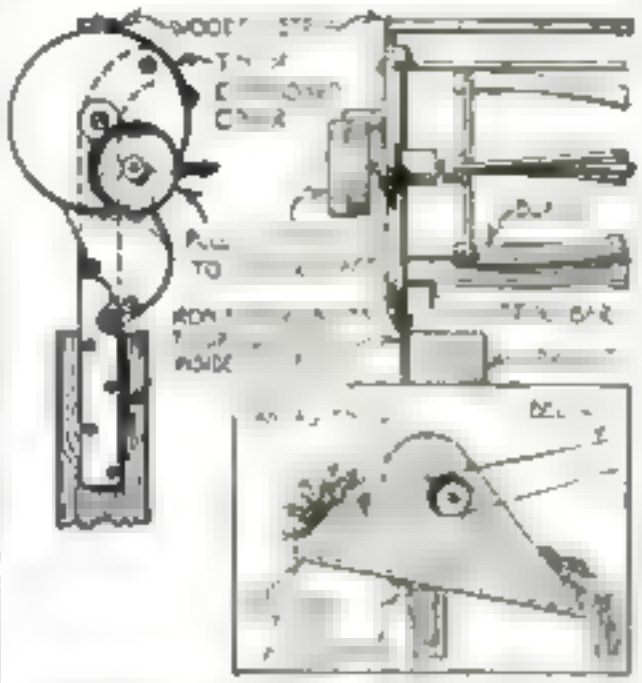
Now cut out a scale (celluloid or cardboard) and glue to top of the magnet.

Your voltmeter is now completed, with the exception of the calibration, which you may accomplish by testing one or more batteries with a standard voltmeter (found in any garage or machine-shop) and noting the spot on the scale of your home-made voltmeter. By changing or tightening the springs, any desired size of scale can be made.

Also, the above will answer for an ammeter, by merely changing the scale.—DELBERT ADAMS

Convert Your Lawn-Mower into a Feed-Cutter

IN these days of high-priced farm machinery a satisfactory green-feed cutter of medium small capacity can be built out of an old lawn-mower, provided the blades and cutting-bar are not past usefulness. The accompanying illustrations show, in a way, how this is done, but should not be taken as conclusive, as the make and design of lawn-mowers differ. Their differences, however, are not radical, and the adaptation of any one of them for the previously mentioned purpose will follow somewhat after these suggestions. The suggestions are broad enough so that any one with a little mechanical ingenuity can use his particular mower to cut green feed, either by hand or by power.



Details of the process that converts your lawn-mower into a green-feed cutter

First, disassemble the lawn-mower to the extent of taking off the drive-wheels, the roller, and the handle trunions. This leaves the mower frame with the blades and cutting-bar intact.

Erect two wooden posts so that their outside faces will be slightly closer than the distance between the insides of the mower frame. Now set the mower upon the tops of the posts so that it rests upon the roller slides as shown. Then measure for two long sheet-iron or sheet-steel supports, which can be bolted to the outside of the posts and to the inside of the mower frame so as to hold it rigidly in this position. The exact style, size, and shape will depend upon the style of mower you are using, but will probably be somewhat like that shown in detail.

If no handy bolt- or screw-holes occur on the inside of the mower frame to attach the support to, some will have to be drilled and tapped. When the supports are finally secured so as not to interfere with the turning of the blades, bolt their lower ends to the posts. If supports are solid enough, they should hold the mower rigid and not allow undue vibration.

Drill and tap two holes in the top

and back side edge of each side of the frame, as shown, to which screw two strips of wood. Then cover with sheet tin or heavy cardboard as a shield to prevent the cut fodder from flying.

Set as large a pulley as possible on the free end of the knife shaft. If the drive-wheel stud interferes, saw it off. Pulley must be large enough to drive the blades easily against the cutting pressure when under a load.

Next, build an inclined wooden platform to set on the top of the posts and close under the cutting-bar. Incline it so that the material goes in under the blades where they strike against the bar instead of leaving it. Cover each side of the mower, from the top down, with heavy canvas, attaching the bottom edge to the sides of the platform. The pulley should be allowed to be outside this cover. This will entirely inclose the apparatus and leaves an opening front and back for the material to be pushed in against the cutters and to pour out at the rear after being cut.

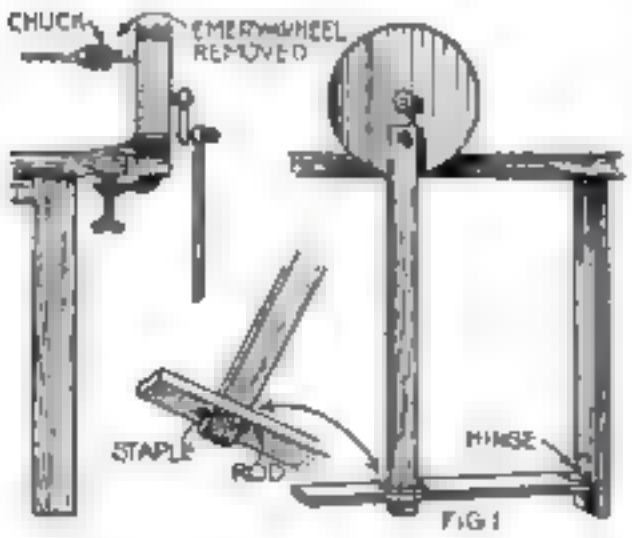
When using power, drive the cutters just fast enough to make a good clean cut.

This apparatus is good for clover, hay, alfalfa, straw, etc., for chickens and small stock feed.—THORTON HALLETT.

The Emery-Grinder as a Drill and Lathe

THE illustration shows how an old emery-grinder was made into a serviceable drill and lathe after the surface of the emery had become badly worn and uneven.

The shaft which originally held the emery was removed and threaded to take a small chuck, not unlike those with which small hand-drills are



Here is a way to transform a useless emery-grinder into a drill and lathe for small work

equipped. The bearings were then rebabbitted and worn parts and play taken up with bushings, and the parts reassembled again.

As shown in Fig. 1, the drill was attached to the edge of the bench, and connected to a pedal, hinged to one of the legs of the bench, by means of a pitman made of a hard wood stick. The length of the pedal and its height

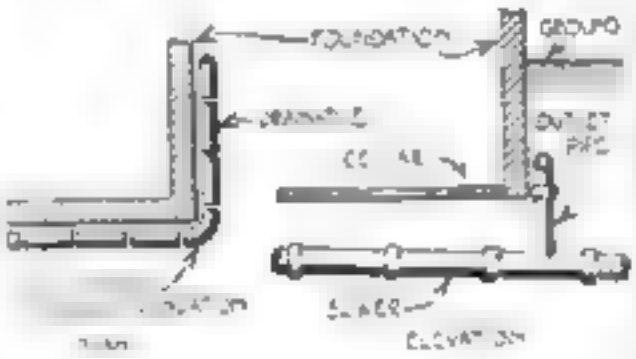
from the floor were governed by the height of the bench and the length of the handle of the emery-grinder.

The pitman was connected to the pedal as shown. A rectangular hole was cut through the pedal slightly larger than the end of the pitman. The pitman was then run through the hole, and a small rod was run through the hole bored in the pitman, held to the under side of the pedal by means of two large staples.

A 2-in. block set up and braced in front of the chuck at the proper distance, completed the device. It was made adjustable, and operated with a lever arm, so that the work could be moved toward the drill as the boring progressed.—DALE VAN HORN.

How to Build a Dry Cellar in Clay Ground

POSSIBLY one of the most annoying places to build a house that is free from cellar water is in clay ground. It seems that no amount of careful and painstaking construction of the foundation will keep out the water. However, there is at least



A drain constructed in this manner will carry off all water from your cellar

one way that proves very successful and that way is made clear in the illustration.

The tile is laid out so as to have it slope gradually to the outlet pipe, which empties into the sewer. The drain tile is the same as that used on farm lands, but, of course, a four-inch tile is the largest that would be advisable.—RAY BAARMAN.

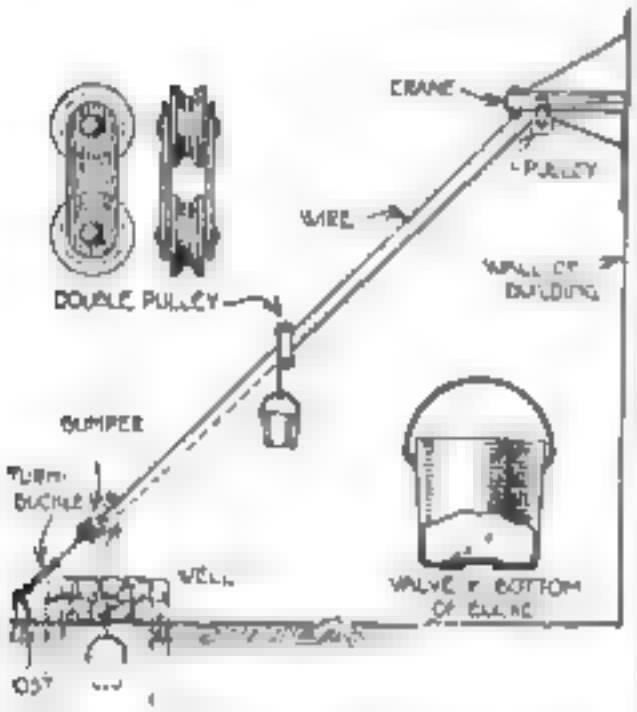
Trolleying the Well Water to the House

SOMETIMES an idea or method is so old that it is new. This method of raising water from an outside well to a room in the top story of a house was in use in Italy in the sixteenth century and even before that, but it is so simple and ingenious that it may find a place in modern rural life. The method, as explained, is the same as the original, but is constructed to use modern appliances.

Drive a post in the ground near the far side of the well-curb and drive an eyebolt in the top. Then erect a crane over the window of the house where it is desired to raise the water and set an eyebolt near the end as shown.

Just back of the eyebolt bolt a large pulley to the crane. This can be of

any suitable pattern. The two eye-bolts just mentioned are then connected with a wire cable on to which has been slung a double pulley somewhat of the pattern shown in detail. This should be large enough to run free on the cable without the possibility of running off the wheel and cramping. Just back of the center of the well put some solid metal substance



This apparatus carries the water from the well to the kitchen, thus saving many weary steps and insuring a good supply

as a bumper to stop the progress of the double pulley. This can be set in the cable any convenient way. A turnbuckle should be placed at the post end of the cable. Then, with everything in place, draw up on the turnbuckle until the cable is taut.

The bottom of the bucket should be arranged as shown in detail. This consists of cutting a round hole in the bottom about 2 in. in diameter. Over this hole, on the inside, fasten a leather flapper which will close when water inside the bucket bears against it, but will raise up when the bucket is being lowered into a body of water outside. The deck-leather of a common pitcher pump will do very well as a valve for this purpose.

Tie a rope to the center of the bail of the bucket and reeve it over the lower wheel of the double pulley and the wheel on the crane, and your "water elevator" is complete.

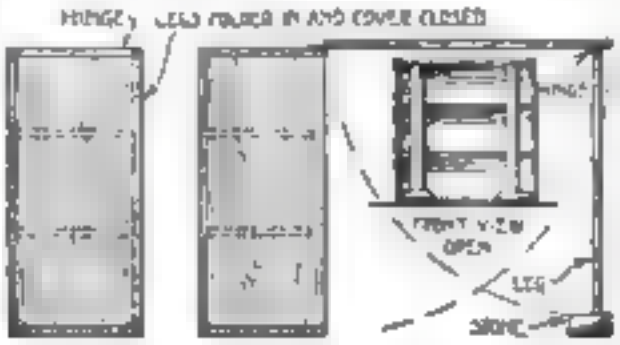
The action is obvious. The empty bucket descends the cable by gravity. When the double pulley strikes the bumper it stops, but the bucket descends the well, fills itself through the valve in the bottom and is ready to be hoisted to the window. As it is raised, the bail strikes the double pulley and the whole is pulled aloft together.

A counter weight on the free end of the rope will assist in raising the full bucket if desired.

Once you install this device, you will use it constantly, for it means getting rid of that tedious and hard job of carting water to the house by hand, and the necessity for economy in the use of water will be done away with.

A Combined Box and Table for Campers

SINCE a very small table must suffice for the camper, the one here shown, which takes up no additional room among the equipment, will be found very desirable, and it can be set up in a moment after unpacking. A strong box is procured of dimensions approximating 28 to 30 in. in length, 24 in. width, and 1 ft. or 14 in. in depth. Such a box will hold the ordinary light camp equipment, and will easily fit under the seat of a spring wagon or in an automobile.



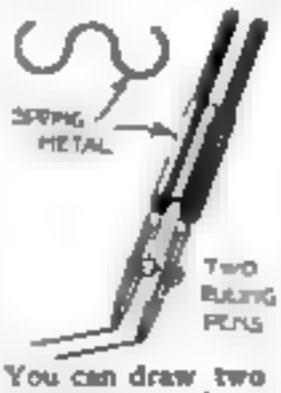
Set on the running-board or in the tonneau of a car this box will accommodate all the camping utensils

The lid is hinged to the box at one end, while at the free end two legs of 1 by 3 in. lumber are hinged to the lid so as to fold against it inside when the lid is closed. These legs are of the same length as the inside measurement of the box. The hinges used are ordinary butts, so that the entire lid and one end of the box form a table of a convenient size.

A division board inside the box will form a convenient shelf when the box is set on end.—H. F. GRINSTEAD.

Hold Two Pens Parallel with a Clamp

DRAFTSMEN who have occasion to draw many lines in parallel will appreciate the little device illustrated herein by which they can set two common ruling-pens in position to do this. Several of these devices arranged for different widths will enable any one to draw parallel lines different distances apart by simply changing the pens from one to the other.



You can draw two lines instead of one by using this clamp

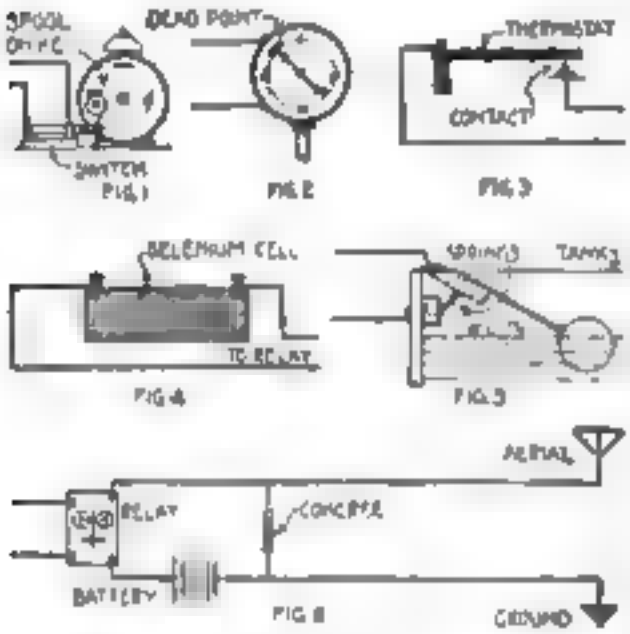
Get a piece of spring metal about an inch long and fully as wide. Then bend it in the shape indicated so the two semicircles will clamp each penhandle securely

Set the pens in place with the points at the same level. Then, when you hold one pen against the rule and draw it along the paper, the second pen will duplicate the line given a distance away.

Six Ways of Automatically Stopping an Engine

WHILE there are many schemes for automatically stopping a gas engine or electric motor, the methods here described will be found to serve nearly every practical purpose. They will be found advantageous in cases where the engine cannot be closely watched and tended, as in pumping water at a distance, shutting off when a certain pressure has been reached, etc.

Fig. 1 illustrates the manner in which the sparking circuit can be broken at a certain time of day. It is done in this instance by attaching a cord to the handle of an easy working knife switch and arranging it to be wound up on a drum, which is like the spool that revolves with the winding



Here are six ways of stopping an engine or motor automatically

key of an alarm clock. As the spool revolves with the ringing of the alarm, the cord winds up and lifts the switch out of contact.

Fig. 2 shows a gage—steam, water, or air—with the hand in constant contact with the metallic face. This completes the circuit to the engine. At the maximum pressure, however, the hand strikes a spot of non-conducting material and the circuit is broken.

Fig. 3 illustrates a thermostat in the line. Suppose the engine is driving air into a large retort forge or furnace and when the heat reaches a certain degree the blast must cease. Arrange the thermostat so that the points are always in contact as long as the heat remains low. Then as the temperature rises, the arm rises, until at the proper degree of heat the points separate and the current ceases, stopping the power.

Fig. 4 operates by the action upon selenium. There may be conditions where the engine should be stopped when a certain amount of light is obtained, or at daybreak. Suppose an engine is to be run each night and must be stopped at daybreak. Then a selenium cell is placed in a primary circuit. Selenium, being a poor conductor in the dark, keeps the circuit open until daylight comes in. Then

the conductivity changes and the circuit is closed. This, by operating a relay, opens the sparking circuit.

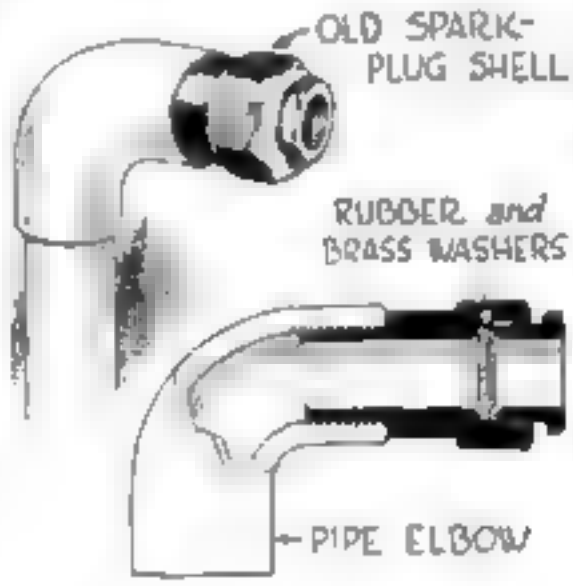
Fig. 5 is a more familiar method and consists of arranging a float in a tank so that when the maximum water level is reached the contact of a switch attached to the float arm is broken, and the engine is stopped.

Fig. 6 is a method of stopping an engine from any distance which can be reached by wireless. An aerial is connected to a relay and battery. In the circuit is placed a coherer. When the key is closed at the sending station, the coherer is induced to close that circuit and the relay operates to open the secondary circuit and the engine stops. This may be increased in efficiency according to the user's demands.

In case an electric motor is to be stopped, the controller handle must be held in place by a magnet, and when the magnet circuit is opened, a spring pulls the motor switch back, out of contact.

A Water-Pipe Coupling Made of an Old Spark-Plug

OLD Necessity certainly is the mother of invention, as I am perfectly willing to admit since my experience of a week ago. One of the joints in my house water-pipe system



How to make an old spark-plug serve as a water-pipe coupling

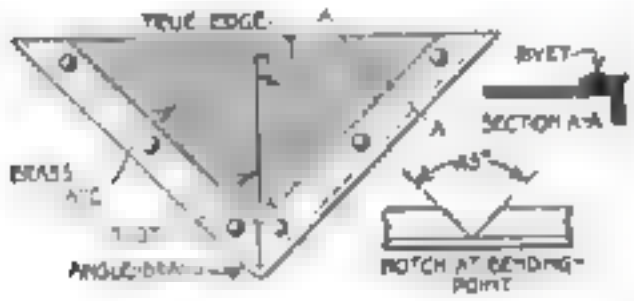
had rusted badly and sprung a leak. I had taken the Stillson wrench to tighten it, and of course split the elbow just when water was badly needed. There is but one cut-off valve for the whole house and it was not practical for me to turn this off for any length of time, or until I had obtained a pipe plug, so I hunted about for a substitute.

As soon as I realized that spark-plugs are threaded with half-inch pipe-threads, it took me but a minute to remove the porcelain from an old one, fit a rubber washer inside the porcelain retaining bushing, and hold it in place by a small iron washer. The old spark-plug still answers the purpose of a pipe-plug, and the water was turned off less than half an hour.—F. L. AVERY.

How to Make a Tool for Centering Shafts

THE exact center of a shaft or disk can be found almost instantly with the aid of the tool here described, and the result will be perfect if the tool is carefully made. The dimensions of the tool will depend upon the needs of the maker, but one tool will handle work of all sizes up to its maximum capacity.

Take a piece of angle-brass and cut out at the center a piece of one flange, making the sides of the cut



If you wish to find the center of a shaft or disk, use this tool

exactly at right angles. Bend the angle-brass until it forms a right angle. See that the brass is perfectly straight and true from every angle.

Cut a triangular piece of sheet brass, making a right-angled triangle that will just fill in the frame of bent angle-brass; the metal need not be more than 1/32 in. thick, unless the tool is a large one, when 1/16 in. will be more satisfactory.

Rivet the sheet brass in place in the frame, countersinking the rivets on both sides, or, if desired, the rivets may be countersunk only on the inside. A smooth job looks better, however, and the countersinking is necessary on the inside.

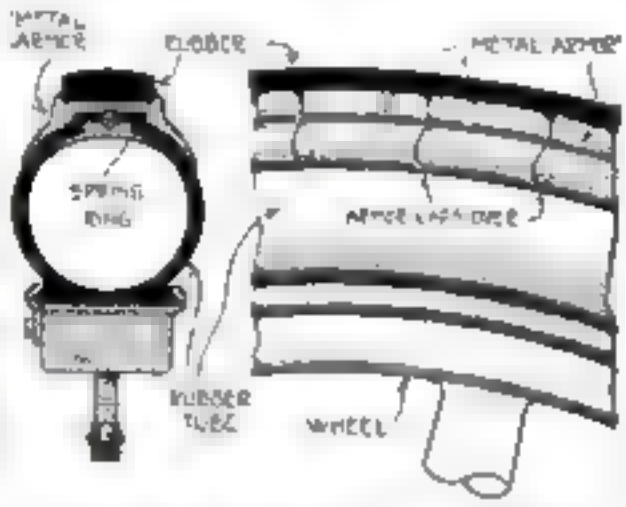
Now very carefully and accurately bisect the right angle and scribe a sharp, deep line from the corner to a point near the wide edge. Then cut out a long slot, one edge of which must coincide exactly with the scribed line; this edge is the working edge and must be perfectly straight and exactly halfway between the legs of the frame. The width of the slot may be anything desired.

To use the tool, rest the end of the shaft to be centered, or the disk, on the flanges of the angle-brass; scribe a line on the shaft, using the true edge of the slot as a guide; turn the shaft at right angles and scribe another line. The point of intersection of the lines will be the exact center of the shaft if the tool has been accurately made. To test for accuracy, turn the shaft to several positions and scribe several lines. If all intersect at exactly the same point, the job has been well done. If not, you have been a little careless somewhere, and it will be necessary to do some work with the dividers to find out where the working edge of the slot departs from the exact bisection of the right angle.

You Cannot Puncture This Kind of Tire

IN the collective detail view of this tire, the parts fit together in the order shown and form a complete armored tire having no inner tube. Metal sections or armor scales extend about the sides of the rubber tube and afford protection against puncture.

The extreme outer section, or part next to the ground, is a solid rubber



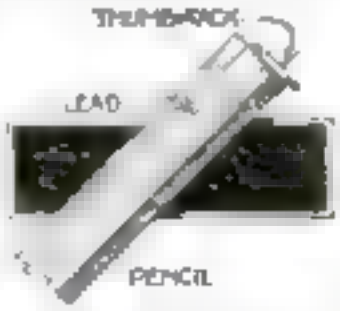
On account of the elasticity of the tire, the armored sections are made so they will glide over one another

band or outer tire. The inner section is a spring ring placed within the tubing, the tubing being split for the purpose. As the spring ring has considerable supporting power, as well as resiliency, the pneumatic pressure in the tube can be quite low.

The different parts are screwed and clamped in such a way that air at low pressure will not escape. It will be seen that the upper portions of the split tube are squeezed between two metal parts, thereby forming an air-tight juncture. Attachment of the complete tire to the wheel is made by any of the usual clincher methods, there being nothing particularly new in that part of the construction.

Steadying a Loose Lead in a Pencil

OFTENTIMES the artist or draftsman is troubled by the lead in even a good pencil working loose in the wood so that the least pressure of the point upon the paper will push it out of sight. This is annoying, to say the least, especially when pencils are scarce at the time. To remedy this is a simple matter.



A thumb-tack in the lead channel prevents the lead sliding

Sharpen the point of a small thumb-tack very sharp and force it down the blunt end of the pencil between the lead and the wood. Be careful not to place it between the seams of the wood, because it is apt to split the pencil.

This is a simple stunt, but one well worth knowing.

How to Make a Salt-Water Aquarium

A SALT-WATER aquarium should be made from one piece of glass. It should be 12 in. high and at least as wide. A salt-water aquarium is much easier to make and maintain than a fresh-water aquarium. The bottom receives a few inches of beach sand or pebbles, according to the character of the creatures to be introduced. This must be washed until the wash water is not discolored or dirty. The salt water is procured from the ocean or it is prepared artificially.

Artificial sea-water contains

Sodium chloride	2 08	per cent.
Magnesium chloride	0 32	per cent.
Potassium chloride	0 05	per cent.
Magnesium sulphate	0 02	per cent.
Calcium sulphate	0 15	per cent.

Although sea-water evaporates, the salts remain in the solution, and if

If placed in a strong light, the water in the aquarium will turn green

evaporation is prolonged, the salts in the water become so concentrated that life cannot exist in it. It can be seen how essential it is that the original proportions remain constant, therefore fresh water is added for all that which has evaporated. And, in order to keep the concentration as uniform as possible, the height of the original sea-water is marked when it is placed in the aquarium.

Then fresh water need only be added whenever the water sinks below this mark.

For aeration, use the green *Ulva* commonly known as sea lettuce. This is the most satisfactory marine plant as well as the most easily obtained. It does well for many months, but it must finally be replaced by fresh specimens. These plants are placed near the surface of the water to a depth of 5 or 6 in. This allows a small clear space near the bottom of the aquarium for a few marine animals. Be careful not to overstock the salt-water aquarium and be sure to remove all decaying material at once, to prevent the fouling of the water.

Have You a Step-Saving House?

The Popular Science Monthly will pay ninety dollars for the best answers

HOW do you save steps in your home? What arrangements or what appliances have you made that save time and reduce work that would otherwise have to be done by hand?

The Popular Science Monthly wants to know just what practical and useful things can be constructed to make every house a step-saving house. For instance: a concealed laundry chute would interest us, if it weren't so old; a space-saving cupboard—another old one. No patented or marketed appliances will be considered.

The Popular Science Monthly offers three cash prizes—a first prize of $50, a second prize of $25, and a third prize of $15 to be awarded in accordance with the rules set forth below.

Rules Governing the Contest

(1) Contestants are not limited to the number of step-savers and time-savers, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be shown clearly either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the writer's idea very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the Popular Science Monthly not later than 5 p. m. on Friday, December 31, 1920.

(5) The judges of the contest will be the editors of the Popular Science Monthly.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best method for saving steps in the house.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the Popular Science Monthly. A description of the methods which win the three prizes offered will duly appear in the pages of the Popular Science Monthly, together with the names of the winners.

(8) The editors of the Popular Science Monthly shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Editor of the Step-Saving House, Popular Science Monthly, 225 West 39th Street, New York City.

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This Tone Amplifier is built entirely of moulded wood, so shaped as to permit proper vibration of tone waves. There is no clashing caused by imprisoned tone waves.

In every particular and considered as a unit, the Brunswick Method of Reproduction is one of the greatest advancements in the phonographic art. It brings final perfections, new refinements.

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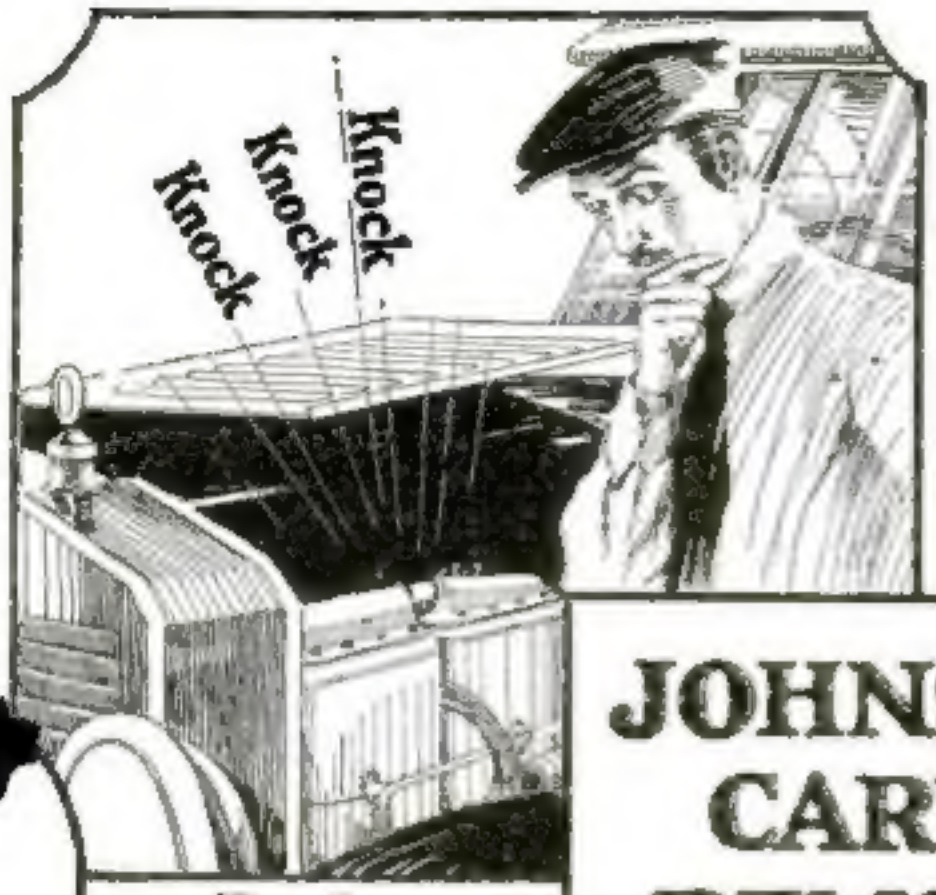

Before

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